This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

THE HILL KINK BOOKS

SCREW THREAD KINKS

COLVIN-STANLEY

Digitized by Google

Library
of the
University of Wisconsin

Digitized by Google

Digitized by Google

THE HILL KINK BOOKS

SCREW THREAD KINKS

Digitized by Google

THE HILL KINK BOOKS

Compiled by F. H. Colvin and F. A. Stanley
Associate Editors of the *American Machinist*

Each cloth, 4x6, illustrated, 50 cents postpaid

ORDER NOW

PRESS TOOL KINKS
SCREW THREAD KINKS
PATTERNMAKING KINKS
MILLING MACHINE KINKS
REPAIR KINKS
TOOLMAKERS' KINKS
JIG AND FIXTURE KINKS
DRILL PRESS KINKS
DRAWING ROOM KINKS
SCREW MACHINE KINKS

HILL PUBLISHING COMPANY
505 PEARL ST., NEW YORK CITY
6 BOUVERIE STREET, LONDON, E.C., ENG.

American Machinist — Power — The Engineering and Mining Journal

Digitized by Google

THE HILL KINK BOOKS

Screw Thread Kinks

COMPILED BY

F. H. COLVIN AND F. A. STANLEY

Associate Editors of American Machinist

1908

HILL PUBLISHING COMPANY

505 PEARL STREET, NEW YORK

6 BOUVERIE STREET, LONDON, E.C.

American Machinist — Power — The Engineering and Mining Journal

Digitized by Google

Copyright, 1908, by the Hill Publishing Company

Hill Publishing Company, New York, U.S.A.

Digitized by Google

146786
OCT 5 1910
TDS
.C72
S 6935801

INTRODUCTORY WORD

THE kinks and other information given in this book have been selected from the experience of thoroughly practical men, as originally published in the *American Machinist.* This volume forms one of a series of this nature, aiming always to make available out-of-the-way information when most wanted. In this form the Kink Books, which can be kept in the tool-chest or the pocket, and always referred to, will, we feel, meet a demand and serve a good purpose.

F. H. COLVIN.
F. A. STANLEY.

NEW YORK, November, 1907.

Digitized by Google

Digitized by Google

SCREW THEAD KINKS

GEARING A LATHE TO CUT ANY THREAD

THE selection of the proper gears for screw cutting is a problem as old as the engine lathe itself, and yet it probably comes up more frequently in the shop than any other, not even excepting the question of turning tapers. Instead of attempting to give any hard-and-fast rules for this, it seems better to try to understand just "how" the carriage and tool are moved in screw cutting, so that it will be perfectly clear "why" we make each move in the game.

SIMPLE GEARING

Fig. 1 shows the head of an engine lathe witb simple gearing. Gear *E* is solid with the lathe cone and turns with it in the direction of the arrow. Neither *F* nor *G* is in mesh with *E*, so

Digitized by Google

no motion is given to any of the gears or the lead screw.

Raising gear bracket *I* so as to mesh *G* into *E*, and tracing the turning direction of the various gears, we find that *L* turns in the same direction as the spindle, so that a right-hand thread on the lead screw will move the carriage toward the head and cut a right-hand thread, as is usual. It is easy to trace out the direction in which gears will turn in several ways. One is to remember that every other gear turns in the same direction. This means that *E*, *H* and *L* will all turn the same way. The gear *F* is not in the train, but is running idle in this position. Another way is to follow the gears themselves with your eye or with a stick (but don't risk a finger if they are in motion), as shown by the arrows in Fig. 2, following the motion till you come to the end or to the particular gear wanted. The fact that the large intermediate gear does not mesh with *H* does not affect its motion, as the smaller gear is on the same shaft, or what is commonly called the stud.

Digitized by Google

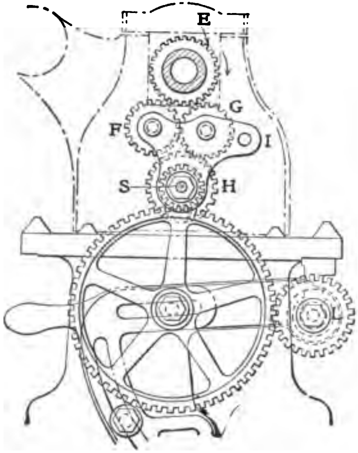


Fig. 1. — Simple Gearing for Regular Screw Cutting.

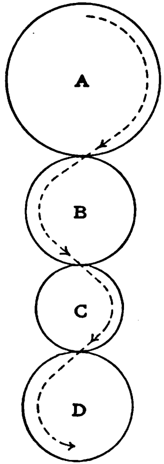


Fig. 2. — Following Motion of Train of Gears.

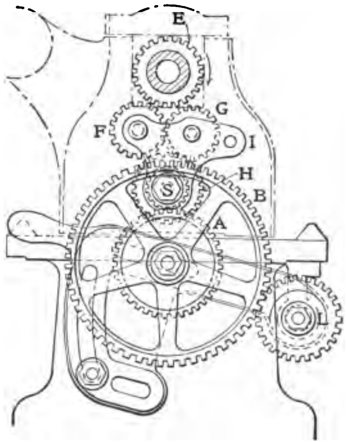


Fig. 3. — Compound Gearing for Fast Threads.

Digitized by Google

Reversing the Lead Screw

To cut a left-hand thread, the handle *I* is lowered until gear *F* meshes with *E*. This makes *L* run in the reverse direction, as *E*, *G* and the intermediate run the same way. This is the object of the gear *F*, which is idle when cutting right-hand threads.

Having settled the direction in which the gears run, the next question is, the gears required to produce the right thread on the work. It is easy to see that if the lathe spindle and the lead screw revolve at the same rate, the carriage will advance one thread at each revolution and cut the same thread as the lead screw.

With the gearing shown in Fig. 1, this will not be the case, because the gear on the stud *S* has fewer teeth than the main driving gear *E*, so that the lead screw will turn at a slower rate, and cut a finer thread.

Finding the "True" Thread of Lead Screw

The first thing to do is to see if the stud *S* turns at the same speed as the spindle. This

Digitized by Google

can be done by counting the teeth in E and in H. These are usually the same, and, if so, the stud turns at the same rate as the spindle and the lathe is geared "even." If these gears are inside the head, and hard to get at, put gears having the same number of teeth on both the stud and the lead screw, and take a cut on an old piece of stock to see what it cuts. If the thread is the same as the lead screw, the gears are "even," as before; if not, call the thread you cut in this way *the true thread of your lead screw* in all cases, and ignore the actual pitch of your lead screw in all calculations. This will save much time and trouble in future.

After you have found the true pitch of your lead screw it is easy to find the gears for any thread as long as the train of gearing remains the same, that is, not compounded in any way.

Calculating the Gears

All you have to do is to multiply both the pitch to be cut and the true pitch of the lead screw by the same number and you get the gears to use.

Digitized by Google

Call your lead-screw pitch 6, and you want to cut a 10 thread. Multiply both 6 and 10 by 4 and get 24 and 40, or by 5 and get 30 and 50, or by 6 and get 36 and 60. It doesn't matter which pair you use if you put them on the right place.

Just remember that the gear you get by multiplying the pitch of lead screw goes on the stud, and you'll have no trouble. The other, of course, goes on the lead screw. Let us see why, so there will be no need of remembering or taking any one's say so.

The screw to be cut in this case is 10 pitch, slower than the lead screw. So the carriage must move more slowly than to cut a screw the same pitch as the lead screw. This means the lead screw must revolve more slowly than the spindle; to do this, the larger gear must go on the lead screw.

Suppose you select gears with 30 and 50 teeth and put the 30 on the stud. Then every revolution of the stud will turn all the gearing in the train just 30 teeth, which will revolve the lead screw $\frac{30}{50}$, or $\frac{3}{5}$ of a revolution, which is correct

Digitized by Google

for a 10 thread with a 6-pitch lead screw. But it isn't necessary to bother with this figuring unless you want to prove the "why" of it to yourself.

A Few Simple Rules

If you want this in a little rule or rules, you can say: multiply true pitch of lead screw and pitch of thread to be cut by any number that will give two gears that you have for that lathe.

Put the gear obtained by multiplying the thread to be cut, on the lead screw.

Or, if the pitch of the thread to be cut is *faster* than the lead screw, the smallest gear goes on the screw. If slower than lead screw, smallest gear goes on the stud. But — don't apply these rules unless you know what thread the lathe will cut, with even gears on both stud and lead screw.

Compounding the Gears

So far it has been plain sailing with a direct train of gears, but when you begin to double up or compound it is necessary to keep your weather

Digitized by Google

eye open for squalls. They don't arrive if you take time to be sure you are right, but lie in wait for the fellow who "knows it all" or who "never makes a mistake."

Compound gearing is necessary to give the lathe a large range of threads, as it isn't practical to use a 160-tooth gear to cut a 40 thread, as would be necessary with a 6-pitch lead screw and a 24 gear on the stud. So "compound" or change the gearing between stud and the lead screw, as in Fig. 3.

Where the Difference Comes In

Here all the gearing between the spindle and the stud is the same as Fig. 1. But instead of the stud gear driving the same large gear as drives the gear on lead screw, as in Fig. 1, the stud gear drives gear *A*, and fastened to this and turning with it is gear *B*, which drives the lead-screw gear *L*.

The gear *A* is one-half the diameter of *B*, and has one-half as many teeth. As they both turn together, one revolution will move *A* 60 teeth

Digitized by Google

and *B* twice this, or 120 teeth; and as *B* drives *L*, then *L* will be driven 120 teeth also, or twice as fast as though it were driven direct from *S*, by both meshing into the same intermediate gear, as in Fig. 1. The compounding in this case is "geared up" to cut a rapid thread, such as $1\frac{1}{2}$ to the inch. With straight gears this would call for $16 \times 1\frac{1}{2} = 24$; and $16 \times 6 = 96$. If we have no 96 gear we gear up the compound attachment, as shown, and use a 48 gear on the stud, the 24 on the lead screw.

To "gear down" for cutting a finer thread, as at 40, the stud *S* would drive the large gear *B*, while *A* would drive lead-screw gear *L*, through an intermediate. This brings us to the form of compound gearing shown in Fig. 4, which is quite common on modern lathes, and is also somewhat puzzling unless you pick the arrangement to pieces. So this is the next step.

A Compound Cone of Gears

The upper sets of gears *A*, *B*, *C*, are loose on the shaft or pin, except where made to drive

Digitized by Google

with it by the feather or key *K*, shown engaged in *A*. Gears *B* and *C* are now running idle. Gears *D*, *E* and *F* are keyed solidly together. As shown, the lathe is simple geared from *A*, through *D* and *G*, to lead screw *H*. Calling *A* 24 teeth, one turn will revolve *D* the same number of teeth, which also moves *G* 24 teeth, and revolves lead-screw gear *H* once, as this has 24 teeth. So far this is simple gearing, as shown in outline by Fig. 5.

The next change is to move gears *G* and *H* in toward the head, so as to mesh in with *E*. This is shown in Fig. 6. Now *A*, with 24 teeth, drives *D*, having 48 teeth. *E*, with 36 teeth, drives the intermediate gear *G*, and screw gear *H*.

When *A* revolves one turn, or moves 24 teeth, *D* also must move 24 teeth, or one-half a turn. But *E*, also making half a turn, moves 18 teeth, and this is transmitted to gear *H*, showing that "gearing down" takes place as we move gears *G* and *H* to the smaller diameters of the cone.

Tracing Out the Gear Movement

To find what thread will be cut with this arrangement, just pick out the gears which *drive*

Digitized by Google

from the main spindle to the intermed'ate gear *G*. These are *A* and *E*, in Fig. 6, with 24 and 36 teeth. Multiply them together. This gives $36 \times 24 = 864$. Now take the *driven* gears, *D* and *H* (*G* doesn't count at all), and multiply them together, getting $48 \times 24 = 1152$. Multiply this by pitch of lead screw 6, and divide the whole thing by 864, which gives 8, showing an 8 thread will be cut.

The Gears to Use

Working this the other way, to find what gears to use to cut a 10 thread, we work it in almost the same way.

Multiply the two driving gears *A* and *E* together as before, and multiply this by the thread to be cut. This gives $24 \times 36 \times 10$, or 8640. Then multiply the driven gear *D*, 48 teeth, by the pitch of lead screw 6, and get $48 \times 6 = 288$. Divide 8640 by the 288 and find that 30 is the gear to put on the lead screw.

Digitized by Google

The Next Change

Shifting the gears *G* and *H* in toward the head and putting both collars *X X* on the outside, so *G* meshes into *F*, gives another step in the change of gears as shown in Fig. 7. As *D* has 48 teeth and *F* 24 teeth, *F* will drive *G* just half as fast as *D* is being driven by *A*, and gear the lead screw down just half, or make it the same as a 12 thread in simple gear.

Remember that gears *B* and *C* are running idle all this time and need not be considered at all.

This takes us through one set of changes and makes clear the process. Moving the pin in so that the key *K* engages *B*, we have an entirely different set of conditions; but they can be followed out in just the same way.

With gears *G* and *H* outside, as in Fig. 4, the gear *B* drives *E*, both having 36 teeth; *D*, with 48 teeth, drives *G* and *H*. The same calculations can be made as before, multiplying together the driving gears *B* and *D* and the thread to be cut and dividing this by the driven gear *E* multiplied

Digitized by Google

by the pitch. This gives the thread that will be cut.

Cancellation Saves Time

Most of this figuring can be avoided by canceling as follows:

$$\frac{36 \times 48 \times 10}{36 \times 6} = \text{gear for lead screw}$$

Similar numbers above and below the line cancel each other, so we cut out both of the 36s. Then 6 goes into 48 eight times, which only leaves 8 to be multiplied by 10, giving 80 as the gear for the lead screw.

This set of changes should be followed all the way through if you have this gearing on your lathe; also the effect of shifting the pin so that *K* engages in *C*, which gives a gearing up of 2 to 1, as *F* has but 24 teeth and *C* 48 teeth.

When Gears Drive Direct

No matter what the lathe or the gearing, when all the gears in the driving train are in direct line, as in Fig. 4, the gear *H* will turn just as

Digitized by Google

many teeth as the number of teeth in *A*, for every revolution of the spindle; and with the gear *H* having the same number of teeth as the gear *A*, the thread cut will be the same as the lead screw.

To Cut 11½ Thread

This particular lathe is equipped with change gears from 24 to 66, varying by six teeth, and includes a 39-tooth gear, but none that will cut an 11½ thread, which could be done with a 69-toothed gear on the lead screw (which is 4 pitch) and the train in a direct line, as in Fig. 4. As 66 is the largest gear in the list, and this cuts an 11 thread, to cut a 12 it is necessary to compound, which is done by leaving pin *K* in gear *A* and moving *G* in to mesh in *F;* a 36 is used on the lead screw. Just to prove this, and not take it for granted, figure it out. The driving gears are *A* and *F*, 24 teeth each. Driven gear is *D*, 48 teeth. $24 \times 24 \times 12 = 6912$. Multiply 48 by 4, the pitch of the lead screw, and get 192. Divide the first by the second and get 36 as the gear for the lead screw.

Digitized by Google

Cutting as Near as Possible

No regular combinations of the gears gives $11\frac{1}{2}$ thread, but we can get very close to it by making a little compound gear of our own by taking off the intermediate gear *G* and fastening two other gears to run on that stud. With the gears in a single train, as shown in Fig. 4, it would take a 69-tooth gear to cut the $11\frac{1}{2}$ thread. But as these are not to be had, we must find something smaller, and make up for the difference by turning it a little more slowly. So we slip off the first collar *X* in the lead screw and fasten together a 42 and a 36 to place on *G*, with the larger gear meshing into *D* and the smaller into the lead-screw gear *H*. Trying this with a 66 gear on *H*, we have as driving gears 24 and 36, and as driven gears 66 and 42. Then $24 \times 36 = 864$, and $66 \times 42 = 2772$. Divide this by 864 and get 3.2 as the ratio between the lead screw and the thread to be cut. Multiply it by 4, the pitch of the lead screw, showing that this combination will cut a 12.8 pitch thread.

Digitized by Google

Cut and Try Method

This shows the lead screw must turn faster, so we try 60 on the lead screw instead of 66, and see what thread will be cut. Repeating the multiplications, we get $60 \times 42 = 2520$. Divide this by the same number as before, as the driving gears have not been changed, and we get 2.91 as the ratio. Multiply this by 4 and find that it will cut a thread having 11.64 pitch, which will do for a short length of thread, if nothing better is at hand.

Trying one more combination, we use 48 and 42 as the compound gears, and come a little closer. The figuring in this case for the driving gear is $24 \times 42 = 1008$, and for the driven gears $60 \times 48 = 2880$. Dividing gives 2.85, and multiplying by 4 gives 11.4 threads per inch.

Another way of doing this, without decimals, is to multiply the driven gears by the pitch of the lead screw before dividing. This will give the thread that will be cut by the combination given. This would work out like this:

Digitized by Google

$$\frac{60 \times 48 \times 4}{24 \times 42} = \frac{11{,}520}{1008} = 11\tfrac{3}{7}, \text{ or } 11.43,$$

as you prefer. Figuring out various combinations in this way will show just what can be done, and by taking care to separate the driving gears from the driven and remembering to put the pitch of the lead screw with the driven gears, because it is driven with them, there will be no trouble even if a number of compounding sets are used.

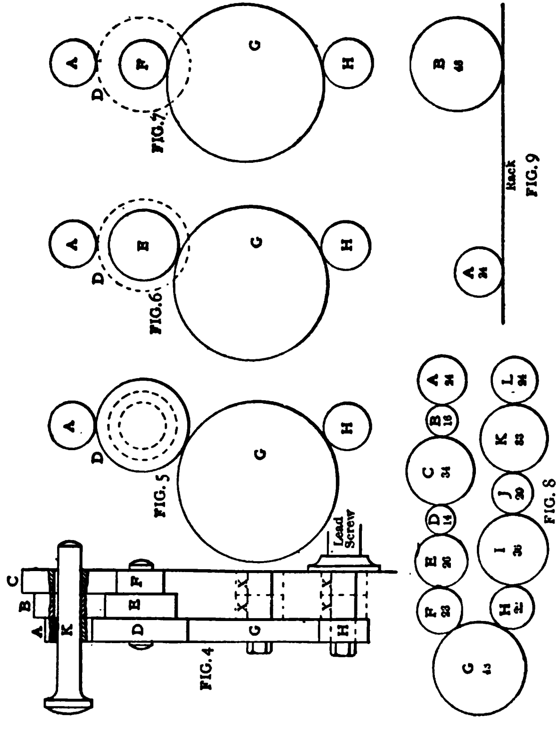
Intermediate Gears Don't Count

A word of caution regarding intermediate gears may save mistakes in some cases.

Any gear which simply transmits motion from a driving gear to a driven gear can be left out of the question entirely. In Fig. 4, with the gears as shown, both *D* and *G* are intermediate and have nothing to do with the thread cut. But moving *G* to mesh in *E* makes *D* a driven and *E* a driver, as both are fastened so as to move together.

In Fig. 8 is a train of gears of varying numbers

Digitized by Google



Tracing Effect of Compound Gears in Threads.

Digitized by Google

of teeth, in which A is the driver and L the driven. Both A and L have 24 teeth. When A makes one turn, L must do the same, because when A moves one tooth, they all follow suit and L moves one tooth also, not allowing for lost motion.

In Fig. 9 the rack is practically an intermediate gear. With A the driver, B will move 24 teeth, or half-way around for every turn of A; and with B as the driver, A will move 48 teeth, or two revolutions, for every turn of B. So by leaving out all gears which simply transmit motion without changing its rate, and keeping driving gears in one lot and driven gears in another, there will be no trouble in figuring out what gears are needed for any pitch of thread.

Fractional Threads

The calculations for gears to cut the 11½ thread show how any thread can be handled, but there is sometimes a chance for getting balled up on threads that are odd and fast, such as 1½-threads to 2 inches. This is ¾ of a thread to an inch

Digitized by Google

and means that the lead screw must make four turns and move the carriage an inch while the spindle is making $\frac{3}{4}$ of a revolution. So the gear selected for the stud must be large enough to turn the lead screw fast enough to move the carriage $1\frac{1}{3}$ inches to each turn of the spindle. With a lead screw of 4 pitch this must turn four times $1\frac{1}{3}$ or $5\frac{1}{3}$ times as fast as the spindle. Using a 24-tooth gear on the screw would mean $5\frac{1}{3}$ times this, or a 128-tooth gear on the stud. If this is larger than you have at hand, use a 64 and put in a 2 to 1 compound gear to double the speed of the intermediate gear, and the thread will be right.

Still Another Way

Sometimes you get an order to make a thread $1\frac{1}{4}$ inches pitch, meaning $1\frac{1}{4}$ inches between threads. The easiest way to handle this is to consider the pitch of the lead screw in the same way, as being $\frac{1}{4}$ inch between threads. Then as $1\frac{1}{4}$ inches is 5 times $\frac{1}{4}$ inch, the lead screw must turn five times as fast as the spindle, using a

Digitized by Google

120-gear on the stud, and a 24 on the lead screw, or a 60 on the stud, with a doubling-up compound gear in between.

If the thread is very odd, such as $\frac{57}{64}$ between threads, which isn't likely to happen, but which you want to be able to tackle if it does, the same method holds good. As $\frac{1}{4}$ is $\frac{16}{64}$, the ratio is 16 and 57. Multiplying both by 2 gives 32 teeth for the lead-screw gear and 114 for the stud. Compounding 2 to 1 would give a 57-tooth gear, which is also odd, and 3 to 1 would give a 38, which is more apt to be on hand.

By carefully following each step you will have no trouble in cutting any kind of a thread wanted, even metric threads, which are sometimes called for.

Cutting Metric Threads

This can be done on any lathe by using a special pair of compound gears having 50 and 127 teeth. It may be necessary to make longer studs for the head and change gears in some cases.

With the 50-tooth gear as the driver of the

Digitized by Google

pair, the 127-tooth being driven from the head, the carriage travel will be reduced in the proportion of 2.54 to 1, because there are 2.54 centimeters to an inch.

The pitch of metric threads is given in millimeters, giving the distance in millimeters from one thread to the next. To use these "translating" gears, as the 50 and 127 are called, it is necessary to reduce the pitch to threads per centimeter, which is 10 millimeters. If the pitch is 2 millimeters, there will be five threads to the centimeter.

Then the lathe is geared just as though you were cutting five threads per inch, with a 24 on the stud and a 30 on the lead screw. The "translating" gears reduce carriage movement just in proportion as a centimeter is less than an inch.

Take care to get the thread measurement into the number of threads per centimeter, then it is plain sailing.

Digitized by Google

CUTTING A METRIC THREAD WITHOUT CORRECT CHANGE GEARS

In a nearby shop a tap was wanted on some work for export to France, and it was to be ½ inch in diameter and 1½ m/m thread.

The best lathe for the work was a 12-inch Hendey-Norton, and the nearest that would come to it was 17½ threads per inch, or .057 instead of .058 inch pitch, as the 1½ m/m thread should be. The difference was made up by setting over the tail center about ⅜ inch and then setting the taper attachment to the same taper. The travel lost by the tool in following the taper brought the error to less than .00001 inch, which was near enough for the job.

CUTTING LEFT-HAND THREADS

Some years ago we had to make a good many hydrant spindles with square left-hand threads cut close up to a collar. The first few took a long time to cut, as it was very difficult to "catch" the thread just clear of the collar even

Digitized by Google

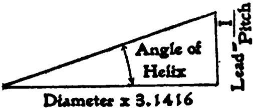
with the lathe running very slow. The difficulty was, however, overcome by running the lathe backwards and inverting the cutting tool. This change gave a cut from right to left as in the usual manner of screw cutting, enabling the tool to cut close against the collar to a drilled hole, and making a nice finish in quick time. The nuts were cut in the same way.

A SCREW-THREAD ANGLE TABLE

THE accompanying table gives the angle of helixes of various pitches and diameters with respect to a line perpendicular to the axis. These angles were worked out with the idea of using them for grinding thread tools for threads of various pitches upon different diameters of work. This table will enable one to set the protractor at the proper angle of side clearance for the work in hand and grind the thread tool correctly without guesswork.

Figs. 10 and 11 show side and front elevations of the thread tool and of the protractor as applied to obtain the proper angle of side clearance to

Digitized by Google



Diameter of Work	1		20	22	24	26	28	30	32
1/4″	50°54′	[illegible]	3°39′	3°19′	3°1′	2°45′	2°36′	2°25′	2°17′
3/8″	40°23′	[illegible]	2°26′	2°13′	2°1′	1°53′	1°44′	1°37′	1°31′
1/2″	32°30′	[illegible]	1°49′	1°40′	1°31′	1°24′	1°18′	1°13′	1°8′
5/8″	27°2′	[illegible]	1°28′	1°20′	1°13′	1°8′	1°3′	59′	54′

Digitized by Google

Digitized by Google

cut a right-hand screw thread. The front edge of the thread tool is used to determine the angle of side clearance. Fig. 12 shows a section taken along the line *a b*, Fig. 1. It will be noticed that line *e f* is shorter than *G H* to give clearance to

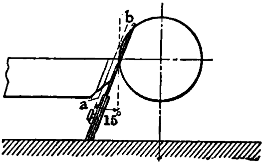


FIG. 10

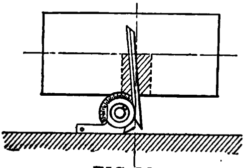


FIG. 11

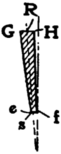


FIG. 12

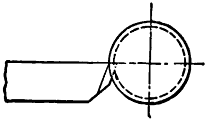


FIG. 13

Using the Protractor.

the cutting edges of the thread tool and also that *G R* is equal to *H R* and *e S* is equal to *f S*. The angle of the helix at half the depth of the thread, Fig. 13, can be used, if desired, and can be approximated to from the table, or figured exactly by the method given at the top of the table.

Digitized by Google

While the table is worked out for single threads, it can be used for double or triple threads by considering the lead equal to the advance of the work in one revolution instead of $\frac{1}{p}$, as given in the table.

It is customary in many shops to have several thread tools in stock to cut these various thread angles, each cutting within a certain range of angles. The table will be useful in determining the best range for each thread tool. We have had this table in use for several years, and find that by grinding the thread tool to the angle of helix for the pitch and diameter of work selected, we are able to cut very smooth, accurate screw threads.

MULTIPLE THREAD CUTTING

The accompanying table will be found useful when cutting multiple threads. When one thread is cut, the feed nut may be opened (the spindle of course being stopped) and the carriage moved along by hand the distance given in the table; the nut is then closed on the screw and the next

Digitized by Google

thread cut. This is a quick and sure method of starting the second, third or fourth thread where the lead screw of the lathe is of the pitch as given in the table.

Say we wish to cut a 3½ pitch double-thread screw: the lathe must be geared the same as for a single, triple or quadruple thread. The tool will of course have to be the same width and the depth of cut the same as for a 7 per inch screw. After the first thread is cut it will appear very shallow and wide. With the lathe spindle idle, the nut is opened and the carriage moved (in either direction) 1 inch; the nut is then closed on the lead screw and the tool is in the proper position to make the second cut.

If the carriage were moved 2 inches, the tool could follow exactly the first groove cut. In the case of a triple-thread screw, if the carriage were moved 3 inches, the tool would follow its original path, and it would do the same in the case of a quadruple thread if moved 4 inches.

The carriage can, of course, be moved 1 inch and the nut closed no matter what the pitch of the lead screw may be (unless it is fractional),

Digitized by Google

Cut	Thread on Lead Screw	Move Carriage
DOUBLE		
1	Even	$\frac{1}{2}$ inch
$1\frac{1}{4}$	Any	2 "
$1\frac{1}{2}$	Any	1 "
2	4	$\frac{1}{4}$ "
$2\frac{1}{4}$	Any	2 "
$2\frac{1}{2}$	Any	1 "
3	Even	$\frac{1}{2}$ "
$3\frac{1}{4}$	Any	2 "
$3\frac{1}{2}$	Any	1 "
4	8	$\frac{1}{8}$ "
$4\frac{1}{4}$	Any	2 "
$4\frac{1}{2}$	Any	1 "
5	Even	$\frac{1}{2}$ "
$5\frac{1}{2}$	Any	1 "
TRIPLE		
1	6	$\frac{1}{3}$" or 2 threads on lead screw
$1\frac{1}{4}$	6	$1\frac{1}{3}$" " 8 " " " "
$1\frac{1}{2}$	6	$\frac{2}{3}$" " 4 " " " "
2	6	$\frac{1}{6}$" " 1 " " " "
$2\frac{1}{4}$	6	$1\frac{1}{3}$" " 8 " " " "
$2\frac{1}{2}$	6	$\frac{2}{3}$" " 4 " " " "
QUADRUPLE		
1	4	$\frac{1}{4}$ inch
$1\frac{1}{4}$	Any	1 "
$1\frac{1}{2}$	Even	$\frac{1}{2}$ "
2	8	$\frac{1}{8}$ "
$2\frac{1}{4}$	Any	1 "
$2\frac{1}{2}$	Even	$\frac{1}{2}$ "

Table for Multiple Thread Cutting.

Digitized by Google

but in order to close the nut after moving ½ inch, the screw must have some even number of threads per inch.

As will be seen by referring to the table, a lead screw with any even number of threads per inch is used in a number of cases, while in several other instances the screw may be of any pitch — either odd or even. In certain cases 4 and 8 per inch lead screws are specified; and in cutting triple threads a 6 per inch screw is required.

FACE-PLATE FOR MULTIPLE THREAD CUTTING

Here is a sketch, Fig. 14, of a face-plate which has been used for cutting triple threads; in fact it can be used on any number of threads by laying off on the auxiliary face-plate the number of divisions required. The auxiliary plate is bolted, as shown, to the front of the main face-plate, with the line on the latter coinciding with one of the graduations on the front plate; the first thread is then cut. Then the plate is unbolted and swung around to the next division

Digitized by Google

and the second thread cut, and so on until you have completed the circle. This method avoids changing or dividing the gears on the lead screw, as is the practice in most shops. The best way

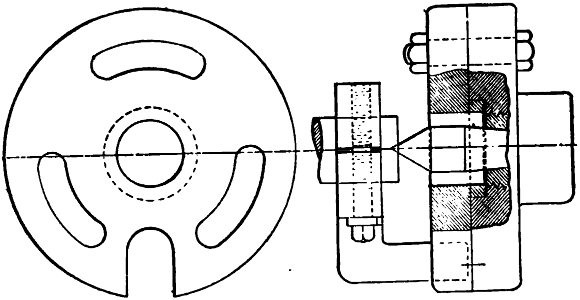


FIG. 14. — Face-Plate for Cutting Triple Threads.

is to rough out all the threads first with a tool a trifle smaller than the width of the thread required, then put in a finishing tool and finish all threads without moving the tool.

FACE-PLATE FIXTURE FOR MULTIPLE THREAD CUTTING

SOME years ago we had to do a deal of multiple thread work, and devised a plate which was

Digitized by Google

used on various numbers of leads with success. On an ordinary driving plate we fitted a plate having, as shown in sketch, twelve holes enabling us to get two, three, four or six leads if required. This ring carried the driving stud, and was clamped at the back of the plate by two bolts as

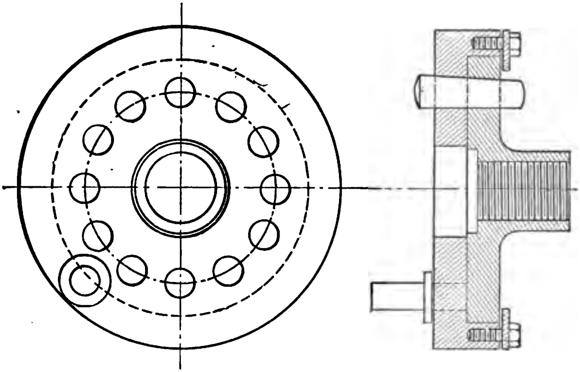


FIG. 15. — Face-Plate for Multiple Thread Cutting.

an extra safeguard. All that was necessary was to slack the bolts off, withdraw the index pin, move the plate the number of holes required, and re-tighten the bolts. It proved a time saver, and we used it on different lathes, as occasion required, by making the driving plates alike and

Digitized by Google

drilling a hole for the index pin. It was found that the index pin worked best when made taper, and a light tap was sufficient to loosen or fix it. The clamping bolts were added on the principle of the Thames bargee, that "it's better to be safe than sorry."

SIZES OF TAP DRILLS FOR U. S. STANDARD THREADS

By the formulas given below, the results, strictly speaking, are the diameters of the bottoms of the threads. The tap drill is, in common practice, the one that is one or two gage numbers larger, for the smaller, or numbered sizes, and one that is about .005 inch larger for the larger sizes. The amount allowed for clearance varies in different shops and on different classes of work.

Size of Tap Drill for U. S. Standard Thread =

$$\text{outside diameter of Screw} - \frac{1.299}{\text{Threads to the inch.}}$$

Size of Tap Drill for $\frac{3}{4}''$ Screw, U. S. Standard Thread, 10 threads to the inch $= .750 - \frac{1.299}{10} =$ $.750 - .1299 = .6201$, size of Tap Drill.

Digitized by Google

Diameter of Screw	Threads per Inch	Size of Tap Drill	Diameter of Screw	Threads per Inch	Size of Tap Drill
$\frac{1}{4}''$	20	.185	2	$4\frac{1}{2}$	1.712
$\frac{5}{16}$	18	.240	$2\frac{1}{4}$	$4\frac{1}{2}$	1.962
$\frac{3}{8}$	16	.294	$2\frac{1}{2}$	4	2.176
$\frac{7}{16}$	14	.344	$2\frac{3}{4}$	4	2.426
$\frac{1}{2}$	13	.400	3	$3\frac{1}{2}$	2.629
$\frac{9}{16}$	12	.454	$3\frac{1}{4}$	$3\frac{1}{2}$	2.879
$\frac{5}{8}$	11	.507	$3\frac{1}{2}$	$3\frac{1}{4}$	3.100
$\frac{3}{4}$	10	.620	$3\frac{3}{4}$	3	3.317
$\frac{7}{8}$	9	.731	4	3	3.567
1	8	.837	$4\frac{1}{4}$	$2\frac{7}{8}$	3.798
$1\frac{1}{8}$	7	.940	$4\frac{1}{2}$	$2\frac{3}{4}$	4.028
$1\frac{1}{4}$	7	1.065	$4\frac{3}{4}$	$2\frac{5}{8}$	4.256
$1\frac{3}{8}$	6	1.160	5	$2\frac{1}{2}$	4.480
$1\frac{1}{2}$	6	1.284	$5\frac{1}{4}$	$2\frac{1}{2}$	4.730
$1\frac{5}{8}$	$5\frac{1}{2}$	1.389	$5\frac{1}{2}$	$2\frac{3}{8}$	4.953
$1\frac{3}{4}$	5	1.491	$5\frac{3}{4}$	$2\frac{3}{8}$	5.203
$1\frac{7}{8}$	5	1.616	6	$2\frac{1}{4}$	5.423

Size of Tap Drills for V Threads.

Size of Tap Drill for V Thread = outside diameter of Screw $-\dfrac{1.732}{\text{Threads to the inch.}}$

Size of Tap Drill for $\frac{3}{4}''$ V Thread, 10 threads to the inch $= .750 \dfrac{1.732}{10} = .750 - .1732 = .5768$, size of Tap Drill.

Digitized by Google

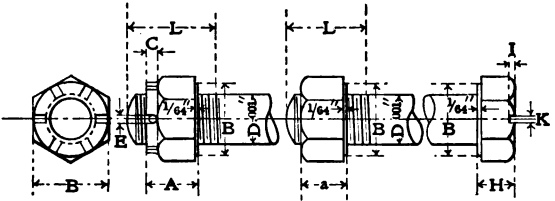
STANDARD SCREWS AND NUTS FOR AUTOMOBILES

THE table herewith shows the standard for screws, nuts, etc., adopted by the "Association of Licensed Automobile Manufacturers." An additional column at the bottom of the sheet gives the length of thread as worked out by the formula given above the table. This may be of benefit to those who are interested in automobile work.

CUTTING COARSE PITCH SCREWS

HAVING occasion, on a certain job to cut some steep pitch worms, we were confronted by the fact that we had no lathe that would give us the required leads, viz., 4 and 6 inches to one turn. All the lathes had either the miserable tumbler in the headstock for reversing the lead or else the new multiple feed arrangement, and all had fine pitch lead screws. The putting in of a new lead screw was out of the question at this time, so we had to find some other way. We counted the gearing in the headstock, and found

Digitized by Google



B = Refers to all Nuts and Screw Heads.

d = Dia. Cotter Pin

D X 1.5 = Length of Thread

P = Pitch of Thread

$\frac{P}{8}$ = Flat

D	$\frac{1}{4}''$	$\frac{5}{16}''$	$\frac{3}{8}''$	$\frac{7}{16}''$	$\frac{1}{2}''$	$\frac{9}{16}''$	$\frac{5}{8}''$	$\frac{11}{16}''$	$\frac{3}{4}''$	$\frac{7}{8}''$	$1''$
P	28	24	24	20	20	18	18	16	16	14	14
A	$\frac{9}{32}$	$\frac{21}{64}$	$\frac{13}{32}$	$\frac{29}{64}$	$\frac{9}{16}$	$\frac{39}{64}$	$\frac{23}{32}$	$\frac{49}{64}$	$\frac{13}{16}$	$\frac{29}{32}$	1
a	$\frac{7}{32}$	$\frac{17}{64}$	$\frac{21}{64}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{31}{64}$	$\frac{35}{64}$	$\frac{19}{32}$	$\frac{21}{32}$	$\frac{49}{64}$	$\frac{7}{8}$
B	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{15}{16}$	1	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{7}{16}$
C	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$
E	$\frac{5}{64}$	$\frac{5}{64}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{5}{32}$	$\frac{5}{32}$	$\frac{5}{32}$	$\frac{5}{32}$	$\frac{5}{32}$	$\frac{5}{32}$
H	$\frac{3}{16}$	$\frac{15}{64}$	$\frac{9}{32}$	$\frac{21}{64}$	$\frac{3}{8}$	$\frac{27}{64}$	$\frac{15}{32}$	$\frac{33}{64}$	$\frac{9}{16}$	$\frac{21}{32}$	$\frac{3}{4}$
I	$\frac{3}{32}$	$\frac{7}{64}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$
K	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$
d	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$
L	$\frac{3}{8}$	$\frac{15}{32}$	$\frac{9}{16}$	$\frac{21}{32}$	$\frac{3}{4}$	$\frac{27}{32}$	$\frac{15}{16}$	$1\frac{1}{32}$	$1\frac{1}{8}$	$1\frac{5}{16}$	$1\frac{1}{2}$

Table of Automobile Screw and Nut Standards adopted by the American Licensed Automobile Manufacturers.

Digitized by Google

that for eleven revolutions of the cone the spindle made one, and this gave us a chance. We took the headstock off of the bed, took out the tumbler gears and bored a hole through under the spindle large enough to insert a flanged bushing which projected inside the head far enough to allow a shaft with gear to reach the gear on the end of the cone pulley. The outer end came out far enough to allow a gear on that end to engage the regular change gears of the lathe. This, of course,

Fig. 16. —Screw to be Cut.

increased the speed of the lead screw eleven times when using the back gears; and, by putting on the change gears for a thread of one-eleventh the required pitch, all was lovely and the worms were easily cut.

Fig. 16 is a sketch of a coarse pitch screw which, because of the unusual coarse pitch, was cut and finished under difficulties. The screw was 30 inches long, 2 inches in diameter and with one thread to 3 inches. After rigging up

Digitized by Google

the gears on the strongest lathe in the place it was found that the slowest speed we could get was too fast, and after ripping all the teeth out of two gears, it was decided to adopt means which would allow of the work being rotated slowly enough for the thread to be cut. A new pair of gears was got out to replace the broken ones. A piece of machine steel was then turned up and reduced at one end to screw into the tapped hole for the gear screw in the end of the lead screw of the lathe, and an 8-inch pulley keyed on this extension piece. A spare countershaft was now located and fastened to the floor. The driving belt was removed from the lathe and we then belted from the main shaft to the countershaft on the floor and from the countershaft to the pulley on the lead screw. We thus reversed matters, and instead of the lathe spindle driving the lead screw, we had the lead screw drive the spindle. Thus while the lead screw fed the thread tool at the proper speed the work turned very slowly and the screw shown, and several others as well, were finished without any further trouble.

Digitized by Google

A DIFFICULT JOB OF SQUARE THREAD CUTTING

THE subject of square thread cutting is one entitled to considerable discussion, therefore a description of a very unusual piece of work of that character may be of interest.

The work was the piece shown in Fig. 17, made of Bessemer steel, with instructions to bore through it, true with the exterior, a 1¼-inch double left-hand square thread of ¾-inch lead, and to make a screw to fit of the same material, as shown in Fig. 18.

Here was the difficulty. A double square thread of ¾-inch lead would be $\frac{3}{16}$ inch square (½ of ½ of ¾ inch) and the double depth of the thread ⅜ inch. Taking ⅜ inch from 1¼ inch leaves only ⅞ inch for the diameter of the hole or bottom of thread, and again, since a chasing tool would need to be run forward and back, the depth of the thread, to cut, and clear when coming out, the size of its shank could not exceed ⅞ less $\frac{3}{16}$ inch, or $\frac{11}{16}$ inch, and would need to be somewhat less for clearance. Now, no boring

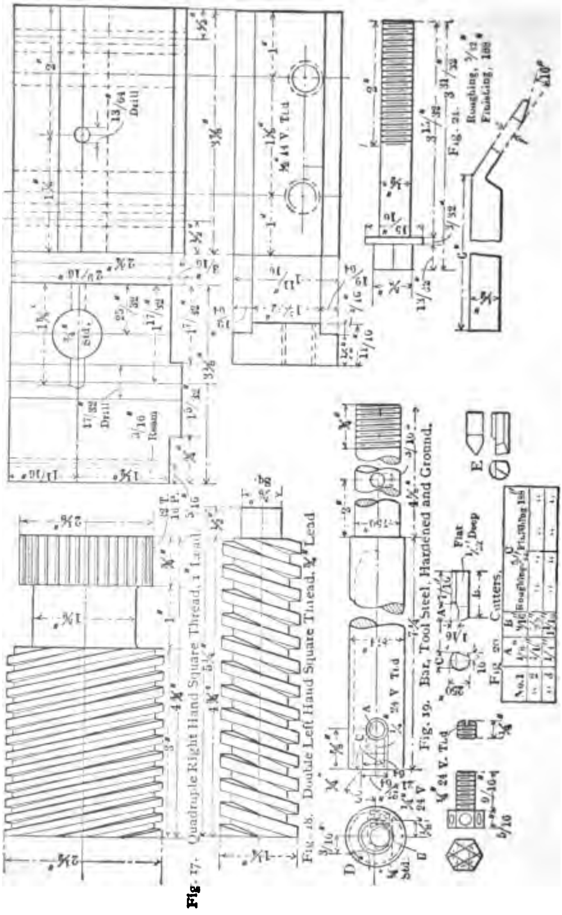
Digitized by Google

tool of so small a size and a length of 5 inches will support a cut $\frac{3}{16}$ inch wide and not spring, and the first bit of spring in the tool would throw it out of position laterally, cause it to gouge, and the result would be destruction, both of tool and of work. Therefore it was necessary to devise a tool which would support the cutter with the utmost rigidity attainable.

For this purpose we designed and made the tool or boring bar shown in Fig. 19 to carry the cutters shown in Fig. 20, and to be held in the block shown in Fig. 21, the bar to possess all the stiffness possible and to be supported in the work, which should serve as a bushing to the bar while being itself operated upon.

The bar was first rough-turned, then the hole *A* drilled two sizes, and one part reamed $\frac{1}{4}$ inch standard and the other tapped $\frac{1}{4}''$-24 V-thread. This hole was placed $\frac{1}{16}$ inch below center so that the tops of the cutters, made of $\frac{1}{4}$-inch drill rod and flatted down $\frac{1}{16}$ inch on top, should come just on the center. The small screw shown was used in this hole to adjust the cutter and to hold it to its work against slipping back. Then

Digitized by Google



The Work and the Tools.

the longitudinal eccentric hole *B* was drilled and tapped on the center of the bar vertically, but $\frac{1}{16}$ inch below the horizontal center line. The hexagon-head capstan screw shown was used in this hole to hold the cutters in position and came on the center line of the cutter.

The severe service required of the bar demanded that it should be hardened and ground, therefore a center must be provided to grind it on. To obtain this we swung the bar in the back-rest, and, to avoid having a wide bearing on one side and a narrow one on the other, bored out the recess *C* of such a size as just to cut into the threads of the hole *B*, then bored the center (60 degrees) $\frac{3}{32}$ inch larger in diameter at the mouth, thus giving a uniform bearing surface $\frac{3}{32}$ inch wide all around, so that when the bar was hardened it was easy to lap the center true. Then, holding the bar in the shoe, we milled the groove *D* to carry away the chips. The $\frac{1}{16}$ inch hole in the shank was drilled to carry a pin to prevent the bar from turning in its seat. The bar was then hardened and ground to .874 inch

Digitized by Google

for clearance on the body and to .750 inch for gripping on the shank.

Then the cutters were made. Taking $\frac{1}{4}$-inch Kidd rod, we cut off pieces to length, flatted them $\frac{1}{32}$ inch deep along one side for a seat for the holding screw, cut them down $\frac{1}{16}$ inch on top to bring the cutting edge on the center, cut down one side square with the top, then brought the cutter to width, giving the second (the advancing) side an angle of 84 degrees from the top, or 16 degrees from the first side, as the angle of the thread was about 10 degrees (10° 48′ 45″ exact), and by making the tools 16 degrees from square on the advancing side and square on the receding side, we obtained a clearance of about 6 degrees on the sharp-edge and about 10 degrees on the blunter one, a difference which served in some degree to compensate for the difference in sharpness. The angle as here given refers to the outside diameter of the screw. At the root of the thread, where the diameter is $\frac{7}{8}$ inch, the angle is 15° 15′ 40″, so that practically no less an angle of tool than 16 degrees could be used. However good or bad this may be in theory, it worked excellently in practice.

Digitized by Google

Of these cutters were made three lengths and two widths as shown, or six sizes, and two of each size, to allow for wear or accident. The different lengths were to secure the amount of advance necessary while still having a sufficient hold on the cutter in the bar, there being no possibility of sufficient adjustment with one tool. Also was made the 90-degree V-shaped cutter shown at *E*, Fig. 20, to run through after the threads were cut, and lightly chamfer the corners.

The block for holding the bar was planed to fit the saddle of a strong, heavily built 14-inch lathe. It was made in two pieces, *F* and *G*, as shown, and doweled together. The clamp block was planed loose in the tongue so that it could take its own position under the tool block, and the latter was solidly bolted down with two $\frac{1}{2}$-inch screws found in stock, a card .01 inch thick being placed between its upper and lower portions. Then the saddle was adjusted to bring the block into position to place the location of the $\frac{3}{4}$-inch hole in the line of centers, the cross-slide was securely gibbed in its place and the

Digitized by Google

block bored to receive the bar. First a drill was used in the lathe spindle and a hole put through the block; a bar was next used on the centers and the hole bored nearly to size and then reamed to $\frac{3}{4}$-inch standard, the reamer being run in the spindle. Thus we had a hole true with the spindle and parallel with the shears of the lathe. We then removed the block, keeping it clamped and doweled together, and drilled the $\frac{13}{64}$-inch hole for the pin, which also passed through the shank of the bar.

Carefully calculating in advance to see that the lathe would cut the thread, we found that it had gears ranging by fours from 32 to 128 teeth, and a lead screw of eight threads per inch. Now $\frac{3}{4}$-inch lead is $\frac{4}{3}$ threads per inch, hence the ratio of lead-screw thread to work was 8 to $\frac{4}{3}$, or $\frac{8}{\frac{4}{3}} = \frac{6}{1} = \frac{2}{1} \times \frac{3}{1}$, and any combination of gears giving that ratio would do, provided they would reach. But the lathe geared direct from the spindle, and had only two gears that would go on the spindle, a 48- and a 64-tooth gear. Therefore the combination $\frac{64}{32} \times \frac{120}{40}$ was selected, the

Digitized by Google

32 gear being put on the screw or at the end of the train, where the stress on it would be the least (because the motion there would be the fastest), and the 120 and 40 gears on the intermediate stud. We were then confronted with this difficulty: a 64-tooth gear to drive a 40-tooth gear running on the same stud with a 120-tooth gear. Clearly it would not reach; but, as the lathe had no reversing device, an idler was required which also served to connect the 64- and 40-tooth gears. To carry the idler it was necessary to make an extra stud, for which, fortunately, there was room on the swinging gear arm.

The next step was to swing the piece in the lathe. Being a finished piece it must not be damaged, and being threaded it would be hard to hold in a chuck without injury. So we obtained one of the pieces into which the screw ran, a heavy casting, broken down to a mere nut, turned it off, using the screw as an arbor, and planed flats on four sides square with each other and the end, which was squared off in the lathe. We drilled and tapped into the end three holes,

Digitized by Google

ran in and jammed three ½-inch bolts and squared off their ends true, leaving them about an inch long. We then split the nut lengthwise, cleaned out the thread, and had a perfect safety holder for the screw, with legs to go against the face of the chuck, to hold out the work against the pressure of the tools, the reason for which will appear later.

Placing the work in its holder in the chuck we trued it up accurately by an indicator on the neck between the screw and gear, having first tested this part on centers and found that it was true, then adjusted the back-rest on the neck and were ready to commence work on the screw itself. The hole was drilled, bored and reamed in the ordinary manner to ⅞-inch standard, tested and found to be true. We then replaced the tool block on the saddle, this time with the bar in place, and the key-pin in the bar, and tightly bolted it down, having removed the card so that nearly the full bolt pressure came upon the bar (the bolts being so near the bar); then tightened the bar up solid with the ¾-inch nut on the end of it.

Digitized by Google

Then we carefully adjusted the saddle to position so that the bar alined with the hole in the screw and would enter it with perfect freedom, again gibbed it hard and removed the cross-feed screw handle to prevent accidental moving of the slide. Gearing up the lathe and throwing in the nut, we ran the bar in and out a number of times, oiling every bearing freely, and finding that everything ran smooth. The lead screw seemed to fly and the carriage travel was proportionately rapid. As the lathe must run backward while cutting the belt was crossed, thus giving a faster speed when reversing than when cutting and allowing us to throw the shifter in the direction the bar was to travel, regardless of which way the lathe would turn, and with this simple fact in mind there was no danger, when in a tight place, of making a blunder from the reversal of the usual order of things.

All was ready for thread cutting. Placing a No. 1 roughing cutter in the bar, we set the bar with a micrometer and tightened it firmly with the capstan screw, using a $\frac{3}{16}$-inch rod turned down on the end to enter the holes in the screw head

Digitized by Google

and tempered to toughen it. The bar and hole were oiled and the lathe started; the bar entered the hole, a smooth and clean-cut chip came curling out, the cutter passed through the hole, and the lathe was stopped. Reaching in between two jaws of the chuck and between the work and the chuck, with the capstan rod, we loosened the capstan screw, releasing the cutter, with a screw-driver withdrew the adjusting screw, allowing the cutter to recede within the bar, threw the shifter to the right, the same as in reversing in cutting a right-hand thread, and the lathe started forward and the bar came sliding out.

Repeating the operation continually, and noting carefully the position of the cutter each time, so that at the next cut we might give it enough but not too much advance, we soon had used the cutter to a point within the range of the second length, or to about one-third of the depth of the thread, so substituted a No. 2 cutter and continued until $\frac{2}{3}$ of the depth was cut, when a No. 3 cutter was put in and the cut carried to a depth of .188 inch, this being the full depth plus .0005 inch for clearance. When the longer

Digitized by Google

cutters were used which could not be pushed back into the bar, they were pushed out at the end of each cut and replaced for the succeeding cut.

Then the lead-screw nut was opened, the carriage run along three threads — $\frac{3}{8}$ of an inch, or $\frac{1}{2}$ of the lead of the screw being cut — the lead screw was again engaged, and the second thread roughed out. Then the finishing cutters were inserted, and with the same care in adjustment for depth of cut run through in the same manner until the full depth was reached and the thread measured about 1.251 inches in diameter. Then the chamfering tool was run once through each thread, lightly flatting the corners, and a good, smooth, clean-cut double thread finished, and the piece removed from the lathe.

It then remained to turn and cut the screw. Tools were made as shown in Fig. 22, for roughing and finishing. The screw was turned and the square end milled, then a thin parallel clamp dog was placed on the square end, leaving enough space between it and the shoulder of the piece for the tool to start into the work. It was then

Digitized by Google

a simple matter to chase the two threads, using the same gearing, but of course uncrossing the belt and running forward to cut.

After cutting the threads to the proper depth and smoothing with the file, we tried the screw in the nut and found it a good snug, smooth-running fit, and the job was in every way satisfactory.

SPRING THREADING TOOLS

THE drawings, Fig. 23, show a special spring threading tool that gives satisfaction and produces nice smooth threads. The body of the tool is in two pieces *A* and *B*, both made of tool steel. The bottom *B* is of $\frac{1}{2}$-inch square stock and has a $\frac{1}{4} \times \frac{1}{8}$ inch slot in it as shown. The top *A* is made of $\frac{1}{2} \times \frac{3}{4}$ inch stock and has a $\frac{1}{4} \times \frac{1}{8}$ inch tongue, a nice fit in the slot in *B*. *A* and *B* are held together by the screws *C*. The front end of the body at *G* is hardened. The tongue and slot are ground and lapped and should be a nice sliding fit. The neck of the tool *H* is about $\frac{3}{16}$ inch thick, the space for

Digitized by Google

the spring is $\frac{3}{4}$ x $1\frac{5}{8}$ inches. The spring is made of spring steel, tempered. On the bottom of the spring there is a tongue *K* to fit into the slot in the body *B*. The adjusting screw *E* is $\frac{1}{4}$ inch, 20 threads; it is to adjust the tension of the spring. The thread tool *F* is made of $\frac{1}{4}$-inch Stubs steel flatted on the top. It is held by the set-screw *I*,

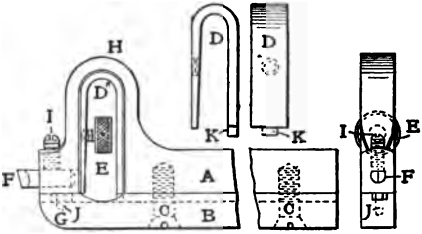


FIG. 23. — Spring Threading Tool.

the hole in the body not being drilled quite through so as to back the tool up. The small pin *J* is $\frac{1}{8}$-inch diameter driven into the lower half of the body *B;* in the upper half *A* there is an elongated slot $\frac{1}{8}$ x $\frac{3}{16}$ inch for it to work in.

This tool is not designed for heavy work; the largest we have ever used it on was a 1-inch 8-thread tap.

Digitized by Google

By adjusting the screw *E* you can get any tension on the spring you want to suit the size of thread being cut. As the nose of the tool is supported the tool cannot spring downward or to the side; when it strikes a hard spot it springs back.

This sketch, Fig. 24, also shows a convenient form of spring tool made of tool steel. A slot $\frac{3}{8}$ inch wide and $1\frac{1}{16}$ inches deep is planed in the body of the tool-holder at *A* and $\frac{1}{16}$ inch below the top of this slot, to allow room for the tool to spring, a $\frac{3}{8}$-inch-square hole is drifted, as shown at *B*. At this point the tool is held by the set-screw *C*. The tool is of $\frac{3}{8}$-inch-square steel and may be of any length desired. For chasing smooth threads on taps, etc., or for using small forming or fillet tools, as shown at *D*, this holder will be found quite useful, as it permits the tool to spring away from the cut and thus prevents it turning or gouging the work.

Fig. 25 illustrates the well-known V-block boring tool-holder and another spring tool, which make a very handy combination. The spring tool receives $\frac{5}{16}$ inch drill rod for cutters, which

Digitized by Google

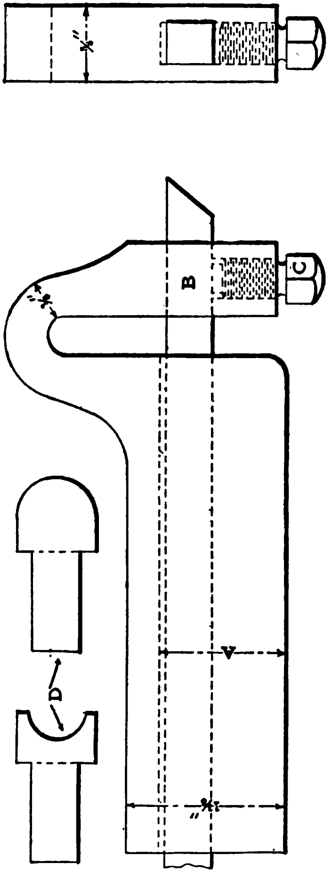


FIG. 24. — Peculiar Form of Spring Tool.

Digitized by Google

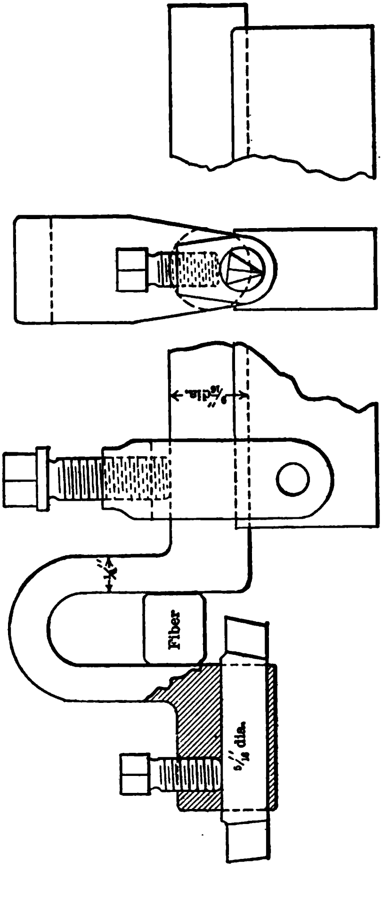


FIG. 25. — Another Spring Threading Tool.

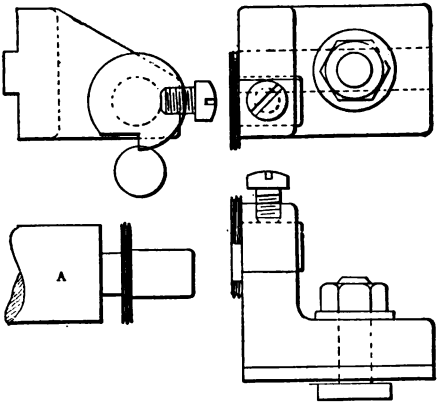
can be shaped at the ends for different pitches, and hardened as hard as possible. Without drawing they will hold the edge very well. The cutters being ground, can be tilted to the right or left as much as desired for clearance, and special cutters for left-hand threads are done away with. The tool was designed for small work, such as taps cut 40 to 60 per inch, but we have made U. S. standard taps 4 threads per inch and 6 per inch Acme taps, the tool standing the strain very well. Insert the fiber block to stiffen the tool sufficiently for roughing out in general, and for finishing coarse threads.

A THREAD-CUTTING TOOL

The accompanying figures, Figs. 26 and 27, show a thread tool that has some good features. It was used on a small bench lathe with rear chasing arm, but there is nothing to prevent its use on any lathe in place of the tool-post. This particular tool was made to thread brass screws 0.370 inch diameter by 1½ inches long, 36 pitch, which had to fit uniformly the whole length. The

Digitized by Google

screws were made from $\frac{3}{8}$-inch brass rod and the tool was fed in until the right size was reached, thus saving a separate operation of turning and leaving no wire-edge or burr, as with a single cutting point.



Figs. 26 and 27. — A Thread-Cutting Tool.

The forming tool was turned up on the end of a bar *A* in a chuck to twice the diameter of the screw and threaded 18 pitch, double, left hand, to give the required angle and shape of thread. The center of the tool-holder was made to come slightly below the center of the lathe for clear-

Digitized by Google

ance, but this changes the shape of the thread so slightly as to be negligible, and in this case the tap was cut with the same tool, which made the shapes correspond. This tool will cut up to a shoulder, is easily set, can be continually reground on the face, and when reset will come to the same place; also the screws being cut can be calipered over the threads with a micrometer both for size and parallelism.

A THREADING TOOL FOR THE TURRET

THE sketches illustrate a threading tool that was made and used in a turret with good success in large holes. Fig. 28 shows the holder with two sets of centers, and shows also the method of holding the thread chaser. One pair of centers was used to turn the holder and the other to turn and thread the chasers, and at the same time give the teeth clearance. The distance between these centers is $\frac{5}{16}$ inch, and they are at right angles to the slot for the chaser. To sharpen, it is only necessary to grind the chaser on its face, as in Fig. 29, which shows a chaser

Digitized by Google

after repeated grindings. Fig. 30 is a new chaser, the thread being cut tapering. As the thread is started by engaging the lead screw in its nut and

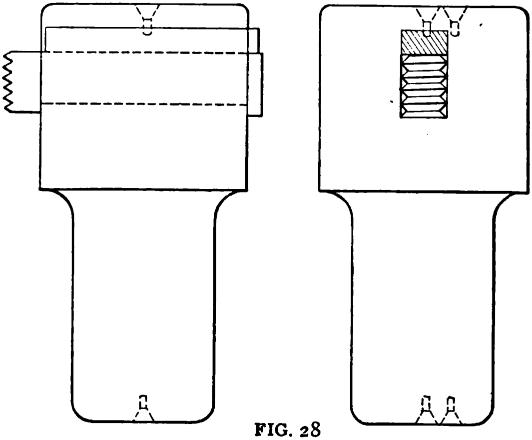


FIG. 28

FIG. 29

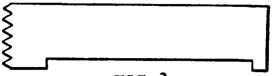


FIG. 30

Threading Tool for the Turret.

by bringing the turret on the cross-slide against a stop for a gage, each tooth on the chaser removes a certain amount of stock as it passes

Digitized by Google

through the hole to be threaded. This amount varies with the pitch and the number of teeth on the chaser. The chaser shown is 8 pitch and contains 8 cutting teeth tapered from the first tooth, which projects 0.0135 inch from the bottom of the thread, each succeeding tooth projecting the same amount beyond the preceding one. As the single depth of thread of this pitch is 0.108 inch, when the last tooth passes through the hole, it leaves a full thread cut to size.

It is not an expensive tool to make, and the amount of work that it will do over the single-point thread tool with its many faults will surprise the most skeptical. A set of chasers of different pitches for this holder will be found an important addition to the turret-lathe equipment.

A COARSE PITCH TAP

THE illustration, Fig. 31, shows a $\frac{7}{8}$-inch tap made from this steel, with $1\frac{1}{4}$ threads per inch, triple thread, angle of thread 40 degrees, double depth of thread $\frac{1}{8}$ inch. This tap was run through at the rate of 5 feet per minute, and it

Digitized by Google

has tapped 75,000 nuts ½ inch thick, or 3125 lineal feet. The nuts were made from bars of free cutting screw stock, such as is usually used for bicycle parts. The tapping was done as a separate operation in a screw machine fitted with

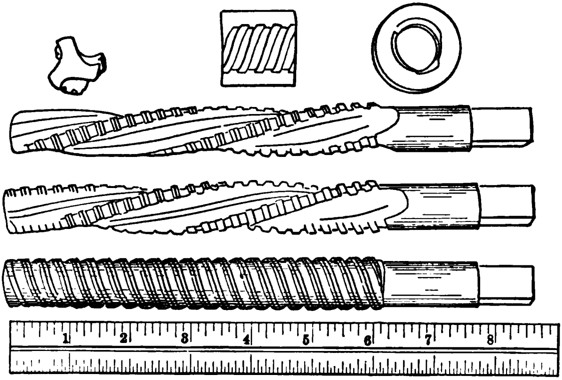


Fig. 31. — Coarse Pitch Triple Thread Tap.

a chuck such as is usually used with wire feed for working bar stock. The nuts were held in the chuck and the tap in a holder in the turret. The tap has been ground three times, including the first grinding after hardening, and is shown as it appeared after doing this amount of work.

Digitized by Google

We had three taps made, as we expected to either break or wear them out on this job.

In the illustration at the top and left is an end view of the tap; at the center a nut somewhat longer than usual and cut in two to show the thread, and at the right an end view of a nut. The upper tap shown is the one that did the work; below this is a tap that has been milled, and at the bottom another ready for milling. The taps were milled spiral at an angle that would bring the cutting face of the teeth at right angles to the thread. Had the flutes been milled straight in the usual manner one cutting edge would have had a pronounced acute angle and its mate an obtuse one. With ordinary proportions this would have been satisfactory, but in this case the tap not only pulled hard, but it was a matter of good luck if we succeeded in getting any thread. An extra thread was chased in the center of the regular thread and at such a taper that the tool would run out within three or four threads of the large end. The regular thread was chased parallel. Three flutes were milled, the cutters being started at the point at

Digitized by Google

which the thread stopped on the small end. The threads were relieved or backed off, but a very small relief was all that was required. The second or auxiliary thread was relieved also and freely because of its being taper. It was $\frac{1}{32}$ inch deep at the point, and in fact at this part was cut below the regular thread. The object of this extra thread was to make tap start easily and to double the number of points to help pull the tap through. We had some trouble in stripping threads until this extra thread was added. The nuts were bored .003 inch larger than the bottom of the tap thread. The best results were obtained by making the first step take out about .005 inch and the last step about .001 inch.

This tap can be run through a nut very easy with a 12-inch tap wrench, as we found by trials by hand in the vise. Another tap was made like this one, but with one-inch pitch. It worked equally well. We do not know just where the limit would be reached, but we believe nuts of almost any size or pitch can be tapped with a tap similar to this one.

Digitized by Google

TAPPING A FAST THREAD BY HAND

An interesting job of tapping valve bodies with a sextuple thread $1\frac{1}{2}$ inches pitch was handled in a very neat way by Elmer Eberhardt, of Eberhardt Brothers Machine Company, Newark, N. J., some time ago. The object of this thread is to allow the stem to unscrew enough to prevent binding when the valve body contracts in cold weather. Whether it works out in practice or not does not affect the methods used.

The valve body is shown in Fig. 32, which shows how nearly this tapping comes to a broaching job. The stems were driven by the chuck at *A*, Fig. 33, the stem centering by fitting the mouth of the chuck and the set-screw holding on the square end of the stem. The dead center was cut away at *B* for the same reason as in milling-machine work, to allow the chaser plenty of room beyond the end of the stem.

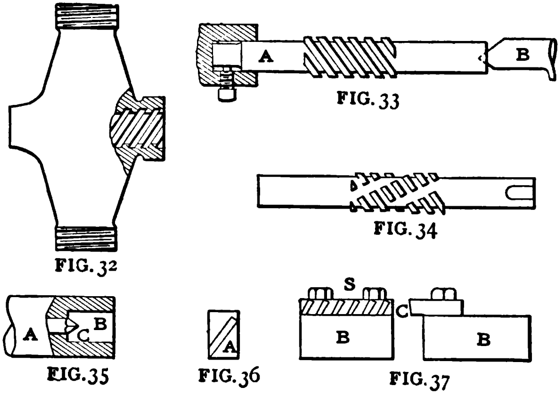
Correcting the Center

Some of the stems were not centered quite true when received, so the little device shown ir

Digitized by Google

Fig. 35 was made. The end of the stem just fits at *B*, and the cutter *C* corrects the center in line with the outside of the stem.

A good idea of how fast this thread is for such a small diameter as $\frac{7}{8}$ inch can be had from the



Valve Body, Stem and Other Tools.

point of the tool used to chase the thread of the tap. See Fig. 36. Next to it is the chaser used for cutting the threads on the stem, and the teeth naturally have the same angle. The cutter *C*, Fig. 37, is fastened to a cast-iron block *B* by cap screw *S*, the complete chaser being clamped

Digitized by Google

to the tool block of the carriage, the lathe geared for a pitch of 1½ inches, and a few passes of the tool finishes the thread.

TAPPING THE HOLE

Tapping a ⅞-inch hole with a square thread of this pitch is a different proposition from ordinary tapping and requires something to give it the right lead while cutting the thread, so the tapping frame shown in Fig. 38 was devised.

The valve body *A* was held loosely by clamps *B B*, while the business end of the machine carried the lead screw *L L*, cut with a single thread of the right pitch. This runs through a bushing or nut *N*, having a babbitt thread for guiding.

This bushing was simply a cast-iron sleeve on which a thread of the right pitch was marked as a guide, and having holes *M M* drilled along this thread. These holes were then filled with babbitt, poured around lead screw *L L*, making the thread of the nut but leaving the cast iron as a bearing and guiding surface for it. The bushing was held by set-screws *S*, so as to be easily removable, as

Digitized by Google

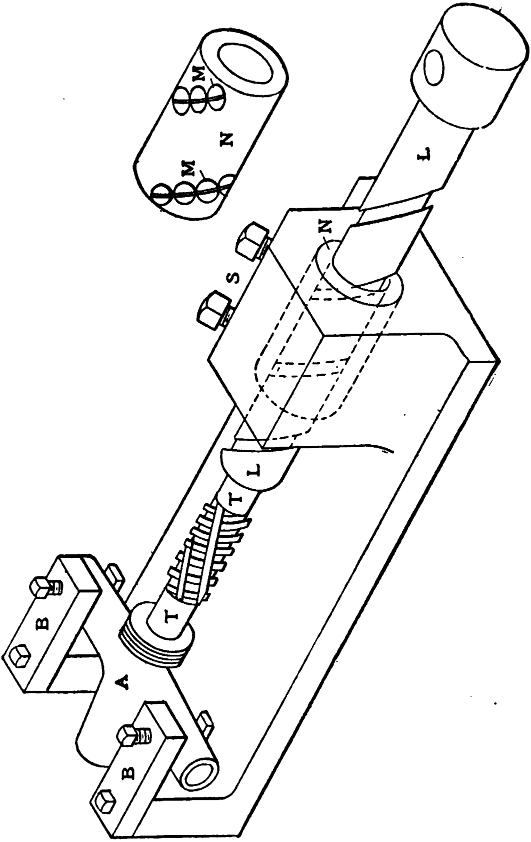


FIG. 38. — Frame and Method of Tapping.

this was only used for the first tap. The second tap needs no guide but the thread already partly cut, and the plain bushing does away with the care that would be necessary to start the second tap in the thread.

The Taps Used

The tap is shown roughly in Fig. 34, but it is hard to make a line sketch that gives a really good idea of it, on account of the grooves being cut spirally so as to be at right angles to the thread and give square cutting edges; and the camera wouldn't show it big enough.

The roughing tap was almost a broach, the front teeth taking a very light cut and the following teeth each taking out a little more, so that very little is left for the finishing or sizing up.

As will be seen, they were tapped by hand with a bar through the outer end of *L*, and a single turn comes pretty near putting the tap through as far as necessary.

Several hundred were made in this way and the methods used ought to contain hints that can

Digitized by Google

be used in other work where fast threads are employed.

BLACK-LEAD FOR TAPPING

SOME men describe the job of tapping holes in tool steel as the "most measley job that came in a machinist's way." We struck such a job the other day, and quite agreed with him at first, but, noticing a cake of black-lead (such as used for cleaning stoves, etc.) on the bench thought we would try what effect it would have; so we greased the tap thoroughly and then ran the cake of black-lead along the teeth of the tap (which was a poor one, but the only one we had of the size), and were surprised at the result. The steel was tapped with little, if any, more trouble than with wrought iron, and with a tap that before would do nothing else but bind and groan.

A CURIOUS TAPPING WRINKLE

THERE was a difficult job in the shop, tapping holes in steel plugs for armor piercing shells.

Digitized by Google

The tapped hole is 2.4 inches in diameter, 8 threads per inch, and the plug 3 inches through. Two taps are used, the roughing tap being 0.01 inch under finish size.

The holes, having been bored and chamfered, the taps were put through and then there was trouble, the front side of the thread being far from smooth. It was not torn but scratched or creased, and the creases were quite deep in some cases and highly polished as though there were some projections on the taps that rubbed rather than cut. The taps were polished and examined and re-examined, but no reason could be found for the ugly scratches which still persisted in coming on the front side, though the thread always appeared in perfect condition when examined from the back of the plug.

After considerable thought it was decided that as the full teeth at the back of the tap approached the chamfered edge of the hole, chips were pinched between the side of the teeth and the thread, and not being sheared off were carried through the plug, thus producing the poor surface. But, even suspecting the cause of the trouble, we were at a

Digitized by Google

loss to know how to keep the chips out and had almost concluded to give up to the inevitable when it occurred to us that the angle of the chamfered edge and the angle of the thread on the tap coming together might have a tendency to pinch and squeeze the chips in, and if we left the chamfering of the edge until after the taps were put through it might prevent this. This proved to be the solution of the trouble and there were no more scratched threads.

FIVE-SPINDLE TAPPING FIXTURE

THE illustration, Fig. 39, shows a fixture for small work which is easily made as well as inexpensive. The gray-iron frame *a* may be placed and fastened to a bench with two screws in the holes *b*. In front it is hollowed to retain the oil when tapping. In the center a stud *c* is driven in tight; on the end of the stud the gear *d* turns against the shoulder of the stud and is held in position with a washer and nut *e*. The gear *d* is made of machinery steel with a handle *f* screwed in it. On the frame *a* are placed five spindles

Digitized by Google

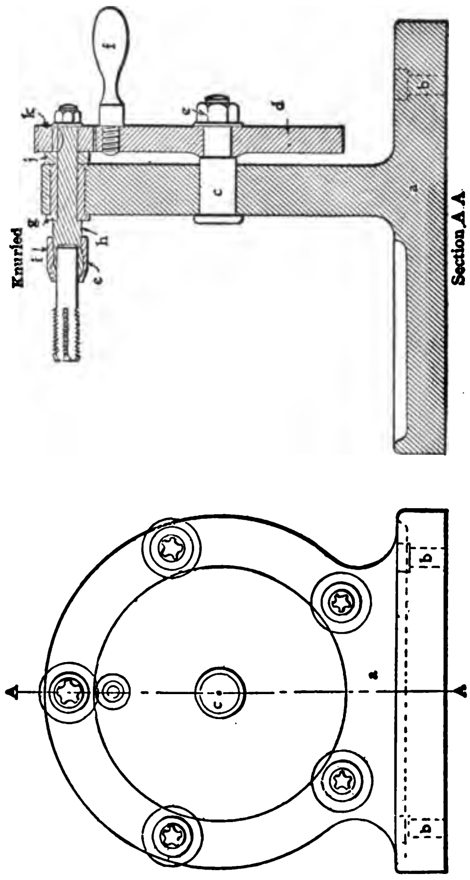


FIG. 39. — Five-Spindle Tapping Machine.

Digitized by Google

for tapping different sizes without changing taps for each operation. One spindle is shown in section, a bushing *g* is driven in the frame.

The spindle *h* carries in its forward end a split chuck, spring tempered, which grips the tap and holds it in position when tapping, while the rear part is threaded to receive the nurled cap *i;* this tightens the spring chuck which holds the tap firmly. A ring *j* is driven on the spindle between the frame and the gear *k* to keep the gears in alinement with each other. The gear *k* is keyed on the spindle, and held securely with a washer and a nut on the end. By turning the gear *d* with the handle, the operator can feel the tension on the tap and thus be able to prevent many breakages. This fixture will drive taps up to ¼ inch, and any number of spindles can be placed in the frame by having one spindle longer than the other, providing, of course, that there is room enough for the work to clear the taps which are are not in use.

Digitized by Google

SPEEDS FOR TAPS AND DIES

Having many inquiries regarding the best speeds for running machine taps and dies in bolt threaders, we referred the inquiry to Mr. Geo. E. Whitehead, superintendent of the Rhode Island Tool Company, Providence, R. I., who replies as follows:

"I have not had much experience on brass work, and will only give speeds that have given good results on iron and soft steel. Work having only a part of a full thread, such as stove bolts and nuts, can be run at higher speeds than if a full thread is desired. The speeds given in the table are for first-class work, are economical of tools and will be found to give excellent results. The slow speed which has been my practice necessitates more spindles to each machine, so that the machine will wait for the operator in preference to the operator waiting for the machine to do its work, thus keeping up the product. For threading iron bolts the speeds are one-half and for steel bolts one-third of those given."

Digitized by Google

$\frac{1}{4}$	about	320	revolutions	$1\frac{1}{4}$	about	70	revolutions
$\frac{5}{16}$	"	310	"	$1\frac{3}{8}$	"	60	"
$\frac{3}{8}$	"	300	"	$1\frac{1}{2}$	"	55	"
$\frac{7}{16}$	"	290	"	$1\frac{5}{8}$	"	50	"
$\frac{1}{2}$	"	275	"	$1\frac{3}{4}$	"	45	"
$\frac{9}{16}$	"	250	"	2	"	40	"
$\frac{5}{8}$	"	200	"	$2\frac{1}{4}$	"	35	"
$\frac{3}{4}$	"	150	"	$2\frac{1}{2}$	"	30	"
$\frac{7}{8}$	"	120	"	$2\frac{3}{4}$	"	25	"
1	"	100	"	3	"	20	"
$1\frac{1}{8}$	"	80	"				

Speeds for Tapping Iron Nuts.

A RIG FOR CUTTING STEEP PITCH WORMS

There were a lot of big worms turned in the lathe some time ago in a way that proved quick and satisfactory.

The lathe used was a 36-inch swing, 20-foot bed and had a compound rest. A short lead screw *A*, Fig. 40, was made of suitable length, the head end resting in the brackets *B*, fastened to the headstock, the other end running in a box fastened to the tail-stock or shears. The half nuts were in a box *C* fastened to the left-hand end of the carriage. A pinion *D*, feathered to the shaft

Digitized by Google

E, meshed with the spindle back gear *F*, giving a stud ratio of 3, 4 or 5 to 1. The shaft *E* was called the stud, and it also journaled in the boxes of *B*. Change gears were put on the free ends of *A* and *E*.

Instead of running the carriage back by hand, an air-hoist was fastened to the front of the bed, the rod being connected to the apron somehow or other, and the valve conveniently located. At the end of a cut the half nuts were opened, and the tool withdrawn by the cross-slide only. Air was admitted to the hoist cylinder, thus bringing the carriage back to the starting point; when the valve was reversed the cross-slide advanced to a stop, the tool fed in to the proper depth of cut by the compound rest and the half nuts closed at the proper moment.

This rig was a great success for knocking out quantities of steep screw work of any form, and a few suggestions are in order: The pinion *D* should be feathered so that it may be slid to the right on the shaft *E*, thus throwing the rig out of action, so that the work may be turned and the ends finished, as the rig in no way interferes

Digitized by Google

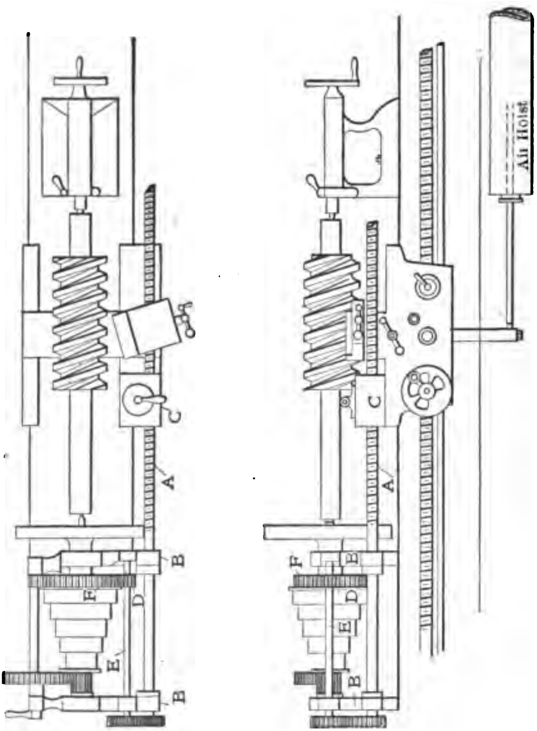


Fig. 40. — Lathe Arranged to Cut Steep Pitch Worms.

Digitized by Google

with the regular work of the lathe, nor are the feeds or change gears molested. The valve of the air hoist might be advantageously operated by foot, but at any rate should be so arranged that air cannot be admitted to the cylinder when the carriage is near the tail-stock. At this point the cylinder should be open to the atmosphere, otherwise the workman might have the screw pulling one way and the air hoist the other, and something disagreeable might happen. For roughing the thread, common cut-off tools should be used, and their nose width should be slightly more than half the width of the thread space at the root. The tools should be fed in at an angle of 14 degrees, thus allowing a little for finishing.

If the worms are all pitched a multiple of $\frac{1}{3}$, then cut the lead screw 3 per inch, and you need not miss half a dozen revolutions waiting for chalk marks to coincide. If, when cutting the first thread of an octuple worm, the carriage can be returned in time to catch the third thread, cut that and follow up with the fifth and seventh, then miss one and catch the second, fourth, sixth and eighth. After which feed the tool forward

Digitized by Google

for another cut, by means of the compound rest, take in order the second, fourth, sixth and eighth threads, then miss one and take first, third, fifth and seventh. When working on long multiple worms the men generally mark the numbers 1, 2, 3, etc., on the worm and also on the carriage with chalk. Each time a cut is taken through a certain number of thread, the number on the carriage is erased; this always tells a man where he is. He does not take a wind cut through one thread and break the tool on the next. The above rig was for cutting worms from 4 to 18 inches in diameter, 6 to 30 inches long, ½ to 2 inches pitch and ½ to 12 inches lead.

THREADING WORM SHAFTS

THE threads were really on worm shafts, and the pitch was about 1 inch; they (the shafts) were forgings with the worm part forged on them. They had to be made this way, as the bottom of the thread was the same diameter as the shaft. They were cut in three operations, two of which were accomplished with a cutting-off tool in the

Digitized by Google

compound rest; the latter was set at the proper angle and the feed obtained with the compound rest screw; although the cross-feed screw was also used. The stop screw was set when the first cut was taken and the tool was withdrawn from the cut with the cross-feed; then in starting the next cut the cross-feed was returned to the stop, without disturbing same, the successive cuts being obtained with the compound rest screw until the threads were finished on one side. By using the cross-feed screw to back off the tool all the work with the compound rest screw was to advance the tool for each cut. These shafts were made in lots of twelve, and the whole twelve were cut on one side of the thread before the other side was touched; then the compound rest was swung round for the other side of the thread and that side of the twelve finished. Then with a tool that fitted the thread two or three light scraping cuts were taken through each worm, using the cross-feed screw for this third operation. In the first two operations allowance was made for this finishing cut. The space occupied by the thread was laid off before starting in on the cutting

Digitized by Google

and when the second operation was completed the center of the threads was left in a helix as the cuts from each side met at the bottom.

MAKING A PIPE-THREADING DIE CUT CLEAN

When we first began to use solid drawn steel tubes the job of cutting perfect threads on them caused a great deal of trouble and loss of material. We were using regular Saunders expanding dies, with the same chasers we had used for charcoal iron tubes. By flattening the points of the chasers and careful grinding we obtained fairly good results for a short time, but directly the dies were the least bit dull they would tear the threads out and ruin the work.

Having usually had perfect threads, we were not satisfied and decided to investigate. We found the cutting angle of the chasers very obtuse, with little or no top rake, as shown at the top in the sketch. This was the arrangement of the chasers in a "regular" right-hand expanding die, the front edge of the chasers being in a

Digitized by Google

radial line and thus presenting a very poor cutting angle; in fact, the metal was torn off and not cut.

To overcome this, we ordered a left-hand die

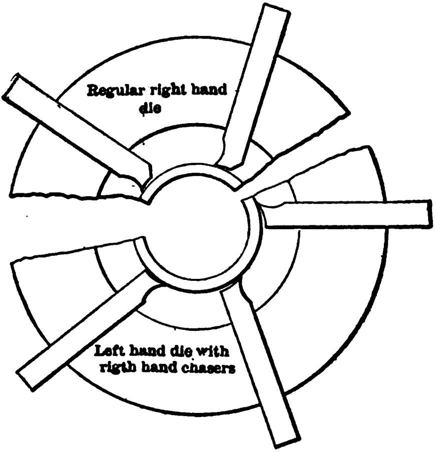


FIG. 41. — Giving Rake to the Cutters.

block fitted with right-hand chasers. This arrangement placed the fronts of the chasers $\frac{3}{8}$ inch in advance of the radial line and gave a very much better cutting angle, as is apparent in the lower part of the sketch. The result was most

Digitized by Google

satisfactory, the cutting coming off in continuous shavings as from a well-ground lathe tool, the threads being perfectly smooth and true. A liberal supply of good lard oil is most essential for perfect screw cutting of any kind, and is doubly necessary for solid drawn steel tube.

Most of our threading is 1½- and 1¼-inch standard right- and left-hand pipe threads, absolutely perfect joints being necessary. Occasionally we have special threads requiring more careful treatment; for instance, cutting 18 threads to the inch on 1½-inch outside diameter No. 14 gage solid drawn tubes. The walls of these tubes were so thin that the dies pulled them out of round and cut through. A solid plug slipped inside the tube as a support secured perfect results.

Similar trouble was experienced in tapping open-hearth steel castings, and we found it necessary to have more cutting edges, with deeper flutes on the taps to give room for the cuttings, grinding the taps with as much top rake as possible. A stream of oil is necessary, as it washes the cuttings away and prevents their fouling and spoiling the threads.

Digitized by Google

THREADING PIPE FLANGES

HERE is a pipe job which required a number of flanges ranging from 14 inches diameter of pipe to 5 inches; the flanges requiring to be faced, bored and chased.

Our first day's work proved to be very discouraging, due partly to the hardness of the iron, the chasing tool especially requiring frequent grinding. After considering various impossible schemes which led into the realms of special machinery, collapsible taps, etc., the idea shown in the sketch suggested itself.

In Fig. 42 *A* is the fixture ordinarily used to hold a boring bar. We had a split sleeve made to fit this fixture and bored for the shank of the 2½-inch pipe tap *B*. The tap was then clamped in place as shown, with one of its cutting edges set at the proper hight, and the rig was ready for service.

We had anticipated some trouble in the larger sizes from the difference in the angle of the thread on the 2½-inch pipe tap and that of the thread to be cut, but no trouble developed from

Digitized by Google

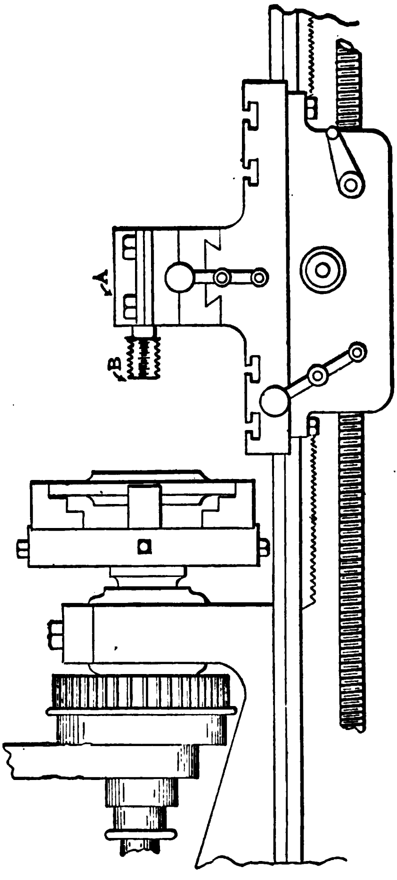


FIG. 42. — Threading Pipe Flanges.

this source. About three traverses of the tap through the work were necessary to complete a thread, the flanges being bored to the proper size and taper before chasing.

The fixture *A* being bored in line with the lathe spindle and the pipe tap *B* being of the standard, $\frac{3}{4}$ inch per foot, taper, insures duplication as far as pitch of thread, shape of thread and taper are concerned.

The lathe was, of course, geared to cut 8 threads per inch, the same as the tap. It is also clear that the $2\frac{1}{2}$-inch pipe tap can be used on any size above $2\frac{1}{2}$ inches, as the pitch of all threads on standard pipe above that size is the same. It also obviates the necessity of a taper turning attachment other than the compound rest, as, after the hole is bored, the tap takes care of the tapered thread.

Another word as to duplication in pipe work. Our practice is to fit the flanges so that they will screw on half the length of thread by hand. On a lot of 12-inch pipe it was found necessary to fit and mark each flange to its place, there being such a great difference

Digitized by Google

in the threads, thus adding greatly to the cost of the job.

A SPECIAL SCREW-CUTTING JOB

THE sketch shows a steel casting of an hydraulic Keil riveter which was required to have a square thread, $\frac{3}{8}$ inch lead, cut in the portion *A*, Fig. 43, which carries the bottom snap, so as to make the bottom snap and holder adjustable. This operation presented certain difficulties, as the portion to be threaded was not in line with the cylinder, but offset, as shown. The cylinder and the drawback cylinder had been bored previously on a horizontal boring machine, the portion to be threaded had also been drilled to $2\frac{1}{4}$ inches diameter, leaving $\frac{1}{4}$ inch to be taken out when mounted in the lathe, with the slide-rest removed and a large angle plate bolted across the saddle, as shown, to which the riveter casting was securely clamped and set to square lines which had been marked on the casting while on the floor plate of the horizontal boring machine. A smaller angle plate was then bolted to the large

Digitized by Google

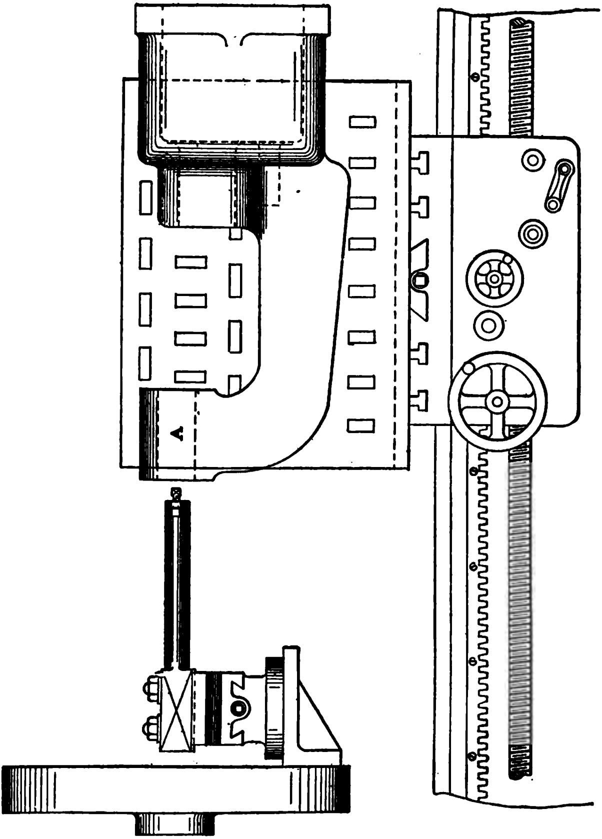


FIG. 43. — A Special Screw-Cutting Job.

face-plate, as shown, and the top portion of the slide-rest was securely fastened to it with four bolts, through the holes drilled in the flange of the rest. The tool-holder was removed, and a boring bar $1\frac{3}{4}$ inches diameter bolted in the rest, as shown. This bar had a square end with a tongue at the bottom, shown dotted, which was a good fit in the T-slot. The bolts passed through holes drilled in the bar. The tool bar was first set dead central with the lathe centers and a square cutter was inserted in the end, which was then presented to the work and the cross-slide moved by the screw until a suitable cut was put on. The lathe was then started and the slide-rest fed up and the hole was bored out to size previous to the screw cutting. Of course the boring bar was not now rotating on its own center, but running round a circle, every revolution more pronounced as the hole got nearer completion. When the hole was bored out to size we put a square threading tool in of suitable section and coupled the requisite wheels up to the screw and proceeded as before, stopping the lathe each time it got through and bringing the rest back by

Digitized by Google

hand, putting a suitable cut on for the next time through by the cross screw on the slide-rest. We completed three of these riveters very successfully without the slightest mishap. The outside diameter of the thread was 3 inches and the length of barrel to be cut 8½ inches.

CUTTING THREADS ON WOOD

The task of cutting standard machine threads on wooden rods is an arduous one, if we try to do it with an ordinary lathe thread-cutting tool.

Our work required a great quantity of such rods, their sizes ranging from 1 inch to 2½ inches in diameter, and from 3 to 6 feet long, with 4 inches of thread on each end. Fig. 44 will show how we satisfactorily do the work.

Belt *A* is round, ½ inch in diameter, and runs over a pulley on the line shaft and over the small pulley on the cutter shaft. The frame *C*, of cast iron, is bolted to the tool-post block. The cutter *F* is made like a milling cutter, having the teeth shaped to give the proper angle to the threads.

Digitized by Google

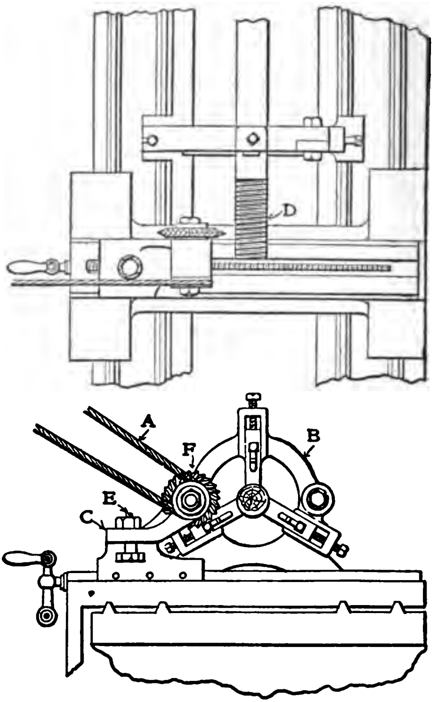


FIG. 44. — Cutting Screw Threads on Wood.

Digitized by Google

To obtain the pitch angle on the thread, a few pieces of thin sheet iron are placed under one side of *C*, the number of shims being determined by the pitch of the thread. The grooved pulley on the line shaft was about 20 feet away so this could be used the whole length of the bed.

SPECIAL TOOLS FOR MAKING THREADING DIES

A SHOP in the Middle West was engaged in the manufacture of a product which required the use of a large number of threading dies, and the foreman was called upon to devise a system for making them with the equipment of an up-to-date tool-room. One size of the dies is shown in Fig. 45. The dies were made from what the steel manufacturer calls middling hard Styrian tool steel, and they cut a very smooth, accurate thread on drop-forged Bessemer steel.

The bars, of commercial length, were cut up into lengths that would turn without using the steady-rest and then turned to a standard diameter, after which they were cut up into blanks

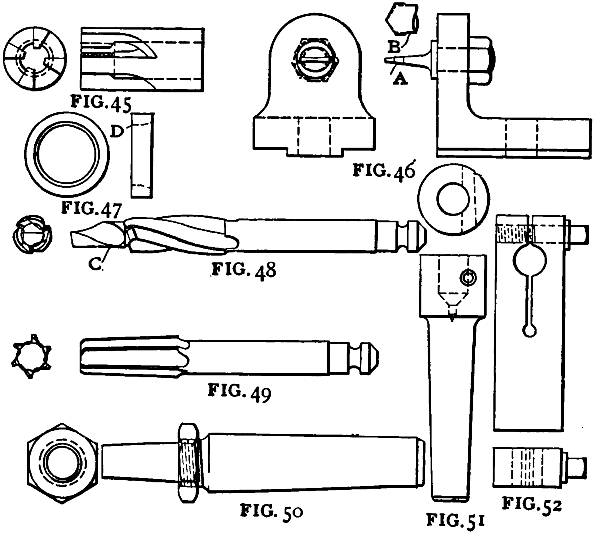
Digitized by Google

two inches long in a cutting-off machine. A 14-inch lathe was fitted up with a two-jaw chuck having slip jaws for different diameters of blanks, also with a special tool-post, Fig. 46, and center, Fig. 51. The tool-post holds a centering tool *A* similar to that ordinarily used, with the added feature of cutting on the side at *B*, the reason for which will be explained later.

A blank was put in the chuck and the centering tool was brought into action preparatory to starting the drill for the long hole. After the hole had been drilled the centering tool was again brought up to the work and used as a boring tool for a depth of $\frac{1}{8}$ to $\frac{3}{16}$ inch, boring to exactly the diameter of the part *c* of the tool shown in Fig. 48, which is a combination of a gun drill and a three-lipped drill. The stop furnished for thread cutting with the lathe was placed in position back of the saddle, as for internal threading, and the side of the centering tool opposite the operator was used to bore the hole in order that the saddle might be brought forward out of the way of the drills and reamer without removing the tool-post and returned to

Digitized by Google

the stop for boring the next blank, thus avoiding the use of calipers after the first blank. If this boring operation is carefully done, the combina-



Special Tools for Making Threading Dies.

tion drill will run dead true, even though the first or stock drill ran out; and it will continue true all the way through the blank. The gun drill part of the tool removes about .022 inch or

Digitized by Google

a side and the whole tool works with surprising rapidity and is very free cutting.

The large part of the hole left by the combination drill was reamed with a taper reamer, Fig. 49, whose cutting edges were serrated (not thus shown) alternately and driven by a driver, Fig. 52, one of which is used to drive the combination drill, the ends of the shanks of both drill and reamer being turned to fit the special center, Fig. 51, which has a taper pin with a nurled handle that fits the taper hole and passes through the groove on the shank and locks the tools in position, so that they cannot "dig in" and break. The reaming operation is done to enable the dies to be milled on the arbor, Fig. 50, which fits the dividing head spindle of the milling machine. The milling cutter cuts into this arbor, but as the cutter enters the same place each cut no harm is done and the dies are well supported. The use of the backing-off nut needs no explanation.

Before removing the dies from the lathe, two or three master taps were run through by power, after which they were fluted and then hobbed

Digitized by Google

with a tap tapering .005 inch per inch. During this operation by hand the prongs of the dies are sprung in by the collar, Fig. 47, so that after tempering they will be in tension when cutting the correct diameter. The reason for this is that trouble was experienced in holding the correct diameter unless the prongs were thus sprung in when in use, and if the dies are hobbed with a tap larger than the diameter which it is desired to cut, the dies drag in the center of the "land" and do poor work. The collar was slipped on part way and a cut was taken with the hob; then the collar driven on till the face *D* was flush with the end of the die and a finish cut taken, bringing the dies uniform in diameter when the hob was run in to the same depth each time on the finish. On the large size dies the combination drill had four flutes instead of three. This tool stands up to its work well and with this outfit two men did the work that formerly required from four to five.

Digitized by Google

SCREW THREAD PRACTICE IN INDIA

THE newly arrived stranger in India is generally struck with the fact that the screws of the country are all left-handed; that is to say, that on entering they do not turn like the hands of a watch, but in the opposite direction. These screws are not cut in a lathe or with what is called screwing tackle; they are made in the most primitive fashion by winding a piece of wire round a rod and soldering it in place. Suppose a screwed stopper is required for a water bottle of metal, the artificer takes wire of the desired size, doubles it, and winds it closely round the stopper, cutting it to the desired length. The two pieces of wire are then removed and one is soldered to the stopper, while the other is soldered inside the neck. Of course the stopper must be made of such a size that when the wire is wound round it, it will just enter the neck of the bottle. Such screws are always a bad fit, as they are made without regard to strength or wearing quality. This method of making screws in metal seems to have been the primitive one

Digitized by Google

everywhere, and it is not many years since the "box" or long nut of vises in England was made in a similar manner. A piece of square rod, of a size to lie between the square thread of the screw, was carefully softened, cleaned, and bent round the screw, care being taken to make it as close a fit as possible. It was finally driven into the box while still on the screw, the screw was then removed, leaving the thread in its place in the box where it was brazed. A good deal of skill was required in the brazing so that the smallest amount of brass should be left in the box which was generally from 10 to 15 threads long. In India the vise is not an indigenous tool and is only used to a very moderate extent, and nuts for other purposes have often not more than one turn of effective thread. In cheap work, like the brass Kohl bottle made in great quantity in Delhi, it is considered sufficient to file a very rough screw thread on the stopper and to jam it into its place.

In the oldest iron work in India there is no sign of screws; bolts are all riveted, and nails that are meant to hold securely are clenched.

Digitized by Google

The boat builder is not content with a clench equal to about three or four diameters of his nails; he will turn one ten to twelve diameters, regardless of the waste of good metal.

Of late years small screw-cutting lathes have become very popular among Indian craftsmen, who seem only to learn the use of the slide-rest and never that of the hand rest. They will make $\frac{1}{2}$-inch studs on the lathe, although they may be made in half the time by hand, and of the use of the hand rest they have only the faintest notion. It is a common incident to see a brass turner squatting on an improvised table before his lathe, while a laborer treads for him or drives by means of a hand wheel. The screwing tackle of the English country blacksmith of fifty years ago would perfectly suit the ideas of the Indian workman. There were stocks and dies, and one tap tapering from $1\frac{1}{4}$ inches to $\frac{3}{8}$ inch with a uniform thread. Being an unwieldy tool, small articles were applied to the tap which was fixed upright in a vise. Fortunately such tools no longer exist.

Digitized by Google

SPLIT NUTS FOR USE IN DRIVING THREADED WORK

USING a nut which has a saw slit in one side can hardly be called good practice, especially if it refuses to come off easily. A cold chisel driven in the slot eases it, but after doing this a few times the result is the second stage in the evolution of the split nut, the halved nut. Now we have two pieces to put on our thread and introduce into the dog, which is troublesome, to say the least. Having a set of threaded carriers or one carrier with inserted tapped bushes seems to be overdoing the matter.

A happy medium in the way of split nuts is shown in the sketch. We have a set of thirteen, ¼ to 1 inch, in constant service for several years, and believe them to be the cheapest and at the same time most effective yet heard from. These are shown in Fig. 53.

They take up a space of only 1 inch by 8¼ inches, placed tandem, with the slots over a narrow upright strip of brass to hold them in place.

Digitized by Google

They are made of cast steel, tapped to a full thread and turned concentric with the threaded hole. The length = d = the diameter of the tap, and the outside diameter of the nut = $1\frac{1}{2} \times d$. After the slots are cut, open the nuts a trifle with a chisel, to insure their being turned on

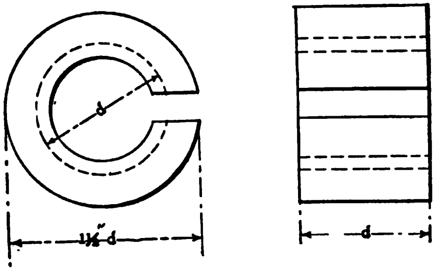


Fig. 53. — Split Nuts for Driving Threaded Work.

freely by the fingers after hardening. It takes but a jiffy to spin them on. They were hardened in oil and given a spring temper by burning off the oil.

A common lathe dog or a three- or four-jawed chuck closes them on to a thread with a grip like grim death.

Digitized by Google

THREADED DOG FOR DRIVING BOLTS

THOSE who have much work of a given size may prefer dogs or drivers instead of split nuts, and this one will be found very useful.

The one shown in Fig. 54 is for $\frac{5}{8}$-inch threaded work and all necessary dimensions are given.

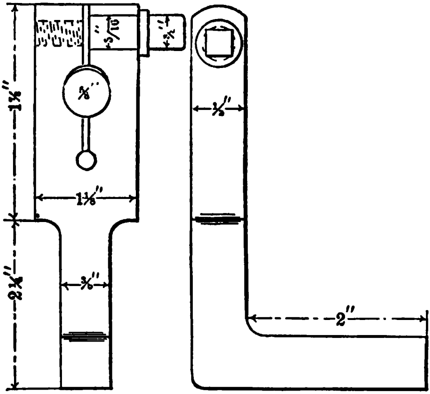


FIG. 54. — A Driver for Threaded Work.

THREADING THIN BRASS RINGS

HAVING a lot of thin brass rings to thread on the inside it became necessary to find a way to hold them. The rings were threaded by holding

Digitized by Google

and locating them in a wood chuck of the shape shown in Fig. 55. This chuck was of soft wood and was turned at *G*, so as to allow of its being

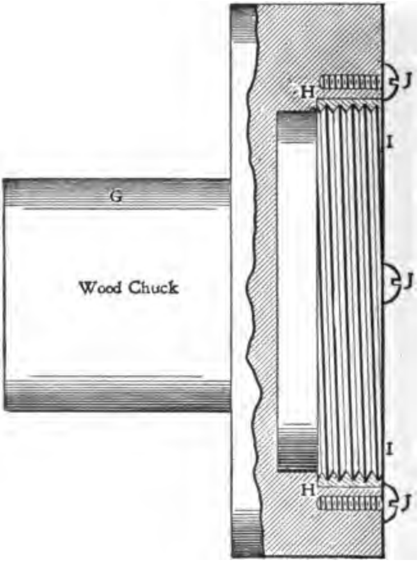


FIG. 55. — Chuck for Threading Brass Rings.

held in the regular lathe chuck; then bored out on the face, so that a brass ring would fit tightly within it and true itself against the shoulder at *H H*. Four round-head screws at *J J J*, when

Digitized by Google

tightened down against the rings, held them nicely and they were threaded without difficulty.

REMOVING DELICATE WORK FROM THREADED MANDRELS

WHEN one has a lathe job on a threaded mandrel it is often quite a difficult thing to unscrew it when finished without spoiling its appearance. A carpenter's wood clamp answers very nicely, but would not do when the job is a delicate one, as it would twist it out of shape.

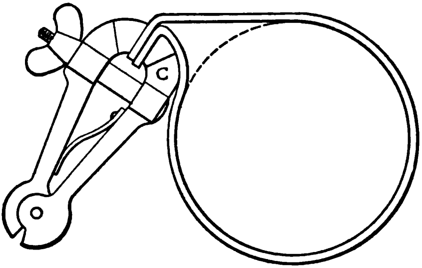


FIG. 56. — Removing Delicate Work.

A piece of leather belting held in a hand vise, as shown in the illustration, will do the trick. The belting must be left long enough to allow the jaw of the hand vise to kink it in at *C*, Fig. 56. This will be found very effective without injuring the work.

Digitized by Google

Digitized by Google

INDEX

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

HAVE YOU THESE?

Practical Planer Kinks. By CARROLL ASHLEY. 80 pages, 5 x 8, 34 illustrations. $1.00 postpaid.

Dimensions and Weights of Pipe and Fittings. 11 x 8. $.50 postpaid.

The Electrical Catechism. Compiled by the *Power* editors from *Power*. $5\frac{3}{4}$ x $7\frac{7}{8}$, 246 illustrations. $2.00 postpaid.

Manufacture and Properties of Iron and Steel. By HARRY HUSE CAMPBELL. Entirely revised in 1907, 641 pages, 6 x 9, cloth. $5.00 postpaid.

Precision Grinding. By H. DARBYSHIRE. 6 x 9, cloth, fully illustrated. $2.00 postpaid.

Steam Turbines. By LESTER G. FRENCH. 340 pages, 6 x 9, cloth, fully illustrated. $3.00 postpaid.

Engine Room Chemistry. By PROF. AUGUSTUS H. GILL of the Massachusetts Institute of Technology. $4\frac{1}{2}$ x $6\frac{1}{2}$, fully illustrated. $1.00 postpaid.

Eminent Engineers. BY DWIGHT GODDARD. 280 pages, 5 x 8. $1.50 postpaid.

Combustion and Smokeless Furnaces. By JOSEPH W. HAYS. 112 pages, 6 x 9, illustrated. $1.50 postpaid.

The Compound Engine. By F. R. LOW, editor of *Power*. 48 pages, 6 x 9, 37 illustrations. $.50 postpaid.

Digitized by Google

Condensers. By F. R. Low, editor of *Power.* 80 pages, 6 x 9, 23 illustrations. $.50 postpaid.

The Steam Engine Indicator. By F. R. Low, editor of *Power.* 208 pages, 6 x 9, illustrated. $1.50 postpaid.

Questions and Answers from the American Machinist. Compiled by Frank Richards. 420 pages, 5 x 7. $1.50 postpaid.

Chordal's Letters. By James W. See. 396 pages, 5 x 8, 32 illustrations. $2.00 postpaid.

The Design and Construction of Cams. By C. F. Smith, F. A. Halsey, and others. 70 pages, 9 x 12, fully illustrated. $3.00 postpaid.

Things that Are Usually Wrong. By Prof. John E. Sweet. 52 pages, 5 x 8, 50 illustrations. $.50 postpaid.

Grinding and Lapping. Tools, Processes and Fixtures. By Joseph V. Woodworth. Author of "*Dies,*" "*Punches, Dies and Tools,*" "*American Tool-Making and Interchangeable Parts,*" etc., etc. 200 pages, 6 x 9, fully illustrated. $2.00 postpaid.

HILL PUBLISHING CO.

505 Pearl Street, - - New York

6 Bouverie Street, - - London, E. C.

The Engineering and Mining Journal, Power, American Machinist

Digitized by Google

89089666101
B89089666101A
EEN
belo
ch
Digitized by Google

m/G

Digitized by Google

89089666101

b89089666101a

Digitized by Google